HEAVY METAL VOCAL TECHNIQUE TERMINOLOGY COMPENDIUM: A POIETIC PERSPECTIVE

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1 Introduction

This licentiate thesis explores a possible method of analysis for the most common vocal elements in heavy metal music from a *poietic* perspective. By the term 'poietic' I mean how such elements are produced by the singers. The concept of *poiesis* is often opposed to that of *aesthesis*, that is how a phenomenon or object is perceived. This thesis provides readers who are not familiar with the mechanisms of the singing voice with an analytical tool for such mechanisms, at least at a basic level.

The object of this study is the music genre of heavy metal. The analyzed corpus stretches from what is generally considered to be the beginning of such genre – the early 1970s – to its most recent forms. Although heavy metal is a considerably broad genre, which offers a large catalogue of possible examples of how the human voice is used, I have chosen to focus on some of the most representative and successful ones. Most of the examples come from the 1970s and the 1980s. The reason is that they are probably the most easily recognizable by readers who have only a general familiarity with heavy metal, and the singers thereby mentioned have a proved influence on later generations of heavy metal musicians. Some of the analyzed corpus is commercially more obscure and perhaps unknown to most readers outside the active heavy metal community, but I deemed such examples as particularly suitable in their specific context.

The initial input for this thesis came to me when I realized how rarely vocals are analyzed in the academic environment of heavy metal studies. This scholarly field, despite its dramatic expansion in the last two decades, still faces noticeable hardship when referring to vocals in a technical way. The central role played by heavy metal singers has been a prolific topic for discussion in many fields of humanities, but the knowledge of the physiology of singing is – at the present time – uncommon within this scholarly branch. At the same time, studies about the voice can be traced back to the 1960s, but they also have entered a phase of feverish exploration and re-organization since the mid-1990s. Furthermore, such enormous corpus of research has very rarely been employed to scrutinize heavy metal and its vocal traditions.

But is there a specific way of singing in heavy metal music? The answer seems to be negative. When it comes to the singing voice, the history of popular music has certainly been a fertile ground for mutual osmotic influences between its various genres, and even between popular music and the

Euroclassical[1] tradition. In the common imaginary, rock and heavy metal music bestow a particular favor on loud, high-pitched, 'dirty', distorted, aggressive and emotionally extreme vocal sonorities. Although singing in heavy metal often presents many different elements than the abovementioned (even quite soft ones), the case can be made that those are probably typical in many popular heavy metal songs. Furthermore, while high pitches and sonic roughness undoubtedly constitute a characteristic of heavy music, their use finds its roots into a multitude of sounds that, way before Black Sabbath, Deep Purple and Led Zeppelin appeared, had already began to carve its own place as an alternative to the smoother, rounder and more elegant singing tradition of Euroclassical music. Paradoxically, the Euroclassical repertoire offers the first examples of such unrefined utterances. In Mascagni's *Cavalleria Rusticana* (1890), the final line "Hanno ammazzato compare Turiddu!" [they've murdered Master Turiddu!"] is usually spoken – instead of sung – and followed by a scream of horror at the tidings of the tragic hero's death. Berg's operas *Wozzeck* (1922) and the unfinished *Lulu* (1934) both present screams, again associated to murderous acts. The screamed, sometimes even primeval voice also appears in works by other later Euroclassical composers such as Crumb, Ligeti, Stockhausen and Berio. Popular music – partly due to the invention of sound amplification as well – has definitely sanctioned the use of a less refined and more aggressive vocal sonic vocabulary. Afro-American artists such as Cab Calloway, Howlin' Wolf, Screamin' Jay Hawkins and Little Richard were among the first to popularize this kind of vocalization, soon followed by 'white' musicians such as The Beatles. While heavy metal music was rapidly developing its main characteristics during the 1970s, Afro-American vocalists from the soul and funk genres – e.g. James Brown, Marvin Gaye and Stevie Wonder – kept including roughness, loudness and distortion into their singing styles. White rock also offered worthwhile representatives, such as Janis Joplin, Rod Stewart or the punk movement. Nevertheless, heavy metal can perhaps be considered the music genre which has most of any other consolidated the trope of a high-pitched, loud and somehow distorted or strained sound, especially with its male idols. Throughout its existence, which nowadays spans over five decades, pitches have stayed as high as in the beginning or even gotten higher, and vocal roughness has reached new tiers of aggressiveness. After being mostly a manly thing for the greater part of its history, singing in a heavy metal band and giving in to harsh and sometimes monstrous vocalizing has become accessible to women as well. The commercial success of bands such as e.g. Led Zeppelin, AC/DC and Queen in the 1970s, Bon Jovi, Van Halen and Def Leppard in the 1980s, and Metallica and Limp

[1] In this thesis, I use the word 'Euroclassical' according to Philip Tagg's *Everyday Tonality II* (2014). The term identifies the musical tradition developed in central Europe between ca. 1700 and 1950 within the cultural context of high and middle-high social classes.

Bizkit during the 1990s, has definitely legalized this music genre and its vocal elements before a mainstream audience.

In this study, I focus on some specific aspects of the production of vocal sounds, precisely on those related to the vocal source of the *vocal folds* and the filter-resonator provided by the *vocal tract*. The equally important mechanisms of the respiration, which constitute the originating power of the voice, are left out of this thesis. Similarly, I chose to rule out the transmission of the vocal sound through a matter of propagation (usually the air around us) and the perception by the listener's hearing apparatus as well. The purpose was to suggest a practical and flexible analytical frame for those who approach the singing voice in heavy metal without a deep knowledge of its working mechanisms.

A considerable challenge in writing this thesis, especially Chapter 3, has been finding a compromise between the ever-growing complexity of vocal science and a manageable comprehensibility even for a reader with no knowledge of it. The thin line that runs between diving into a too technical terminology and a too simplistic explanation of complex phenomena has been a constant warning to reckon during the elaboration of this text. In order to keep the discourse understandable to neophytes of the singing voice, I have tried to refer to a limited number of proven sources in the various fields of vocal science. Experts of the topic might object that – at times – this thesis over-simplifies its content, and to this remark I admit, provided that the final purpose of this work is previously acknowledged: it aims to bridge between two fields of study which – surprisingly enough – have overlapped quite rarely. In order to do so, a certain degree of compromise was unavoidable. This text does not intend to provide an ultimate explanation of vocal phenomena in heavy metal, but rather to offer itself as a practical handbook which, hopefully, will stimulate a higher interest for an underrated and emarginated topic within the heavy metal academic community.

1.1 Research material and previous studies

The research material primarily divides into two categories. One is constituted by a considerable quantity of listening examples I collected and classified from commercially available recordings of heavy metal artists. Such recordings can be found in various formats, physical (CDs, vinyl records, DVDs, etc.) as well as digital (digital streaming services such as Spotify, iTunes, Tidal, Deezer, YouTube). For this academic text, I have solely used the digital catalogue of Spotify, and cited only studio recordings. This choice primarily originated from practical reasons, since referring to material

which is digitally available worldwide for free appeared the easiest solution. Studio recordings usually provide the most famous versions of the songs, and they are the easiest to retrieve. The second category of research material includes previous literature on the singing voice, a minority of which specifically deals with vocals in heavy metal. This latter sub-category of sources mostly addresses the techniques commonly used in what I refer to as *extreme* heavy metal, a sub-genre where the musical and extra-musical characteristics are – generally speaking – brought to more aggressive coordinates, with the voice making no exception.

A far as heavy metal is concerned, the interest of the academic community into this music genre timidly moved its first steps during the 1980s, although it was only in the 1990s that full academic books were published. Deena Weinstein's sociological overview *Heavy Metal. The music and its culture* (1990 and 2000) and Robert Walser's polyhedral and seminal *Running with the Devil. Power, gender and madness in heavy metal music* (1993) legitimized this field of studies. The former delves the stratified sub-culture revolving around heavy metal music until the early 1990s, the latter approaches the early age of heavy metal from various perspectives, including sociology, semiotics, cultural heritage and music theory. Through the instruments of ethnological research, Harris M. Berger analyzed the reality of a geographically limited community of extreme metal musicians and its ties to the broader context of national economic and socio-political conditions in his volume *Metal, Rock, and Jazz – Perception and the phenomenology of musical experience* (1999). Years later, Keith Kahn-Harris looked again at the sub-genre of extreme metal through a sociological lense in *Extreme Metal: Music and culture on the edge* (2007). Esa Lilja published a comprehensive analysis of classic heavy metal in terms of music theory in *Theory and Analysis of Classic Heavy Metal Harmony* (2009), which still stands nowadays as the reference text dealing with the musical content of heavy metal. In more recent times, the quantity of academic material on heavy metal has dramatically increased. Most of it concentrates in the fields of sociology, cultural studies, gender studies and – in general – in humanities concerned with the extra-musical content of heavy metal. Particularly scrutinized is the sub-genre of extreme metal, whereas earlier or softer forms of heavy metal music are noticeably less investigated.

The human voice, on the contrary, has been investigated for at least two millennia. Venturing into a history of vocal sciences here would fall outside the purposes and scientific points of this research, beside requiring an amount of time disproportional to its benefit to this introduction. For the scope of this text, it is sufficient to mention that – for many centuries – scientists tried to unveil the mysteries of the voice from a great variety of perspectives. The development of clinical medicine around the

17th and 18th Century allowed more precise and minute discoveries about the production of vocal sounds. A rapid expansion of the medical research on phonation took place after the Second World War, and only part of the many disciplines involved with topic devoted their attention to singing, being speech and languages also tremendously vast fields of study. From the 1970s onwards, an increasing number of scholars concerned themselves with the singing voice. Worth mentioning in this context are e.g. Minoru Hirano, Ingo Titze, Jo Estill, Johan Sundberg, Jan Švec, D.G. Miller, and Harry Hollien. Surely many more could be added to this list.

A few attempts to analyze vocals in heavy metal have been carried out in the last two decades. Zangger-Borch et al. (2004) conducted an experiment on distorted tones and discovered a relation between the subglottal air pressure, the periodic vibration of the vocal folds and the aperiodic vibration of the supraglottic mucosa. Meanwhile, Sakakibara et al. (2004) analyzed – although within the context of ethnic and jazz singing – vocal techniques commonly used by extreme metal singers as well. Eckers et al. (2009) conducted a pioneering laboratory study on six death metal singers in order to investigate extreme vocal techniques. Although without specifically referring to heavy metal, Zangger-Borch & Sundberg (2011) recognized in power, loudness and high energy the key characteristics of rock singing. Smialek et al. (2012) carried out a spectrographic analysis of techniques used by extreme metal singers. Erbe (2014) explored the possible reasons why the common imaginary associates extreme metal vocals with monstrosity and inhumanity. Berkers & Schaap (2014 and 2015) concerned themselves with the supposed gender inequality among the digital community of YouTube about the covers performed and uploaded by heavy metal singers. Lilja (2016), adopting the concept of 'vocal persona' developed by Tagg, offered an analysis of the different characters interpreted by King Diamond with his voice. Caffier et al. (2018) provided a clinical study about the healthiness of vocal effects involving partial glottal vibration in nonclassical singing. Some of these studies lean on a clearly clinical approach which, to researchers devoid of any understanding on the voice from a medical point of view, might result nearly impenetrable. Others, although specifically dealing with vocals in heavy metal (especially in the most extreme sub-genres), do not occupy themselves with the functioning mechanisms of the voice, or may lack in precision when attempting it. As stated before, my intention is to possibly create a bridge between these disciplines.

1.2 Structure of this thesis

In Chapter 2, I discuss the need for a shared and possibly unified terminology for vocals within the academic field of studies of heavy metal music. In order to do so, I analyze some examples of earlier literature dealing with or mentioning singing. Furthermore, I underline the multiple difficulties for musicologists and – in general – for researchers in human sciences before the technical and poietic aspects of the voice. I also suggest that such disciplines acquire the necessary knowledge from vocal science, which in turn seldom makes efforts to create bridges between themselves and human sciences occupied with the human voice.

In Chapter 3, I provide a brief introduction to the physiology of singing. In doing so, I consciously limit the explanation to a part of the complex mechanisms regulating phonation, and I opt for a possibly basic level of description. As stated in the chapter itself, the purpose is not to provide a complete argumentation of a topic so vast, but rather to provide novices of the singing voice with a simple doorway to access this field of knowledge in a clear and manageable way. The choice of the topics addressed in Chapter 3 mainly comes from the terminology compendium suggested in Chapter 4.

Chapter 4 constitutes the core of this thesis. It provides a threefold division of vocal elements commonly encountered in the different sub-genres of heavy metal: vocal registers, vocal effects and other vocal phenomena. For each of these topics, I provide an explanation of the mechanisms of these techniques or components of the singing voice, as well as a list of examples from heavy metal artists. When possible, photographs and schematic pictures clarify the topics even further and more intuitively.

Chapter 5 presents three examples of analysis on vocals in heavy metal songs, carried out through the terminology compendium provided at the end of Chapter 4. All these songs are picked from the recorded material of the same band, Black Sabbath. Each song is sung by a different singer: Ozzy Osbourne in “War Pigs” (1970), Ronnie James Dio in “Heaven and Hell” (1980), Ian Gillan in “Born Again” (1983). These analyses can obviously be improved in their depth, and can cover more parameters of the vocal sounds, but I believe they offer a clear and manageable vision for researchers in heavy metal music (or popular music studies in general) in case they need specific tools in dealing with vocal parts.

2 Previous perspectives on heavy metal vocals

In this chapter, I introduce the two objects of study which concur in composing the focus of this work: heavy metal music and vocal technique based on vocal physiology. In order to do so, I offer a summary of what heavy metal music is, and I present the primary earlier studies upon which the academic research on this topic is based. Secondarily, I explain why – in my opinion – heavy metal academic studies need to incorporate such paradigm.

2.1 What is heavy metal?

Heavy metal is series of musical practices and a sub-category of the broader musical genre of rock. Previous studies report many different opinions about when exactly heavy metal came into existence (Lilja 2009: 29-47; Weinstein 2000: 11-21, 43-45). I agree with Walser's point of view (1993: 1-16) that the albums *Led Zeppelin II*, *Deep Purple In Rock*, and *Black Sabbath*, all released between 1969 and 1970 by the English bands Led Zeppelin, Deep Purple and Black Sabbath respectively, marked a fundamental milestone in defining the primary features of heavy metal.

Heavy metal's main musical characteristics – especially in its early manifestations – include a) loud volumes and distortion; b) strong riffs usually played on electric guitar, sometimes on keyboards; c) frequent use, according to each singer's style, of high-pitched loud vocals (see Zangger Borch & Sundberg 2011); d) great display of virtuosity derived by the aesthetics of Euroclassical music practices (Walser 1993: 53-107); e) predominance of other modes than major and minor, and preference for modal harmony rather than tonic-dominant (i.e. 'classical') structures (for a definition of 'mode', see Tagg 2009: 45-48); f) influences from many different music genres such as blues, jazz, disco, the already mentioned Euroclassical, pop, Renaissance modality, film music, etc. g) extensive use of power-chords. A power-chord is an amplified and distorted chord – usually performed on guitar or keyboard – formed by the chord root, the perfect fourth or fifth, and sometimes also the perfect octave (Walser 1993: 2-3; Lilja 2009: 102-104). Its particularity lies in the fact that, due to distortion, it sounds fuller and more complex than the same structure without distortion. It is one of the most distinctive sounds of heavy metal music.

At the twilight of the 1970s, this once rather coherent genre began to split into three main sub-genres with further particular characteristics. *Extreme* metal enhanced the roughness and violence of the sound through heavier distortion, vocal harshness, aggressive and hectic drumming influenced by punk music, frequent de-tuning of the string instruments in order to achieve a supposedly deeper and darker sound. For the first couple of decades since its development, mainly due to its uncompromisingly violent sonic and extra-musical characteristics, extreme metal was an esoteric genre, disinterested about achieving mainstream success, and targeted to an exclusive and committed fandom (Weinstein 2000: 48). In recent decades, the academic interest around extreme metal has quantitatively been the strongest, especially from a sociological perspective, with Kahn-Harris's volume *Extreme Metal* (2007) paving the way to countless books, articles and conferences focused on extreme metal religious elements, communities and lyrical as well as visual content. Metallica, Slayer, and Death are fitting examples of extreme metal bands.

On the contrary, *pop* (also called *lite*) metal has been targeted to mass media since the very beginning of its existence. The birth of the television cable channel MTV in the USA (1981) gave wide visibility to many pop metal acts, which offered a possibly less exclusive music than classic or extreme metal. The musical characteristics are similar to the ones of earlier metal, except for the usual shorter length of the songs – tailored to the format of mainstream radio stations – and the inclusion of various pop music elements. From the non-musical point of view, pop metal generally presents androgynous outfit and make-up, and sexual or romantic lyrical themes. Successful pop metal bands are e.g. Bon Jovi, Def Leppard, and Journey.

A third category of artists, including those who had already achieved success back in the 1970s as well as others who directly inspired themselves to the former, adapted their musical and extra-musical material to new trends, but fundamentally remained within the stylistic frame of *classic* heavy metal from the 1970s. Good examples are Ozzy Osbourne, Judas Priest, Iron Maiden, Black Sabbath, and Dio.

These categories are very broad and flexible, and they are adjustable to various perspectives. Therefore, the abovementioned classification is intended to be a flexible tool towards a more practical and rational evaluation of this music genre, instead of a rigid paradigm.

From a sociological point of view, many agree that the subculture of classic heavy metal immediately took distance from the flower-power ideals of the 'hippie' counterculture, which had been very

influential among the young generation throughout the 1960s (Lilja 2009: 29-47). Some causes for such rejection and re-elaboration under a more pessimistic light are arguably to be found in the social fabric of both audience and musicians within the heavy metal community.

Several historical events contributed to such dismay: the police actions against youth demonstrations in Chicago, Paris, Mexico City; the murders of Martin Luther King and Robert Kennedy; the killings of students at Kent State and Jackson State universities in the USA; the tragedy of Altamont in 1969, when a young victim was stabbed to death during a Rolling Stones' concert; the breakup of Beatles; the Vietnam War and the protest movement related to it, etc.

Weinstein (2000: 13) states that "Heavy metal was born amidst the ashes of the failed youth revolution", and that the origins of the heavy metal subculture sink their roots in the appropriation and re-elaboration of youth culture, achieved by blending its ideals about sexuality, politics, hedonism, drug use, and gender with the pre-existing cultural heritage of the working-class.

> By the late 1960s the youth culture had spilled beyond its origins in the fusion between political protest and romantic hedonism to become a style and a mood, a fashion and an ethos, which could be appropriated by youth outside the colleges and the middle class, the sites at which that culture originated… Blue-collar, white, male youth found in the styles and hedonistic pursuits of the 1960s youth culture a means of justifying and enhancing their normal rebelliousness against conforming to the disciplines of a social order that did not provide them with privileges or an attractive future. They adopted the long hairstyle, the casual dress, the drugs, and the psychedelic music of the prevailing youth culture, but they preserved their traditional machismo and romance with physical power, which were epitomized by the images of the outlaw biker gang. (Weinstein 2000: 100.)

Classic metal fans and performers were almost exclusively white people, from lower or middle-level working-class, with a strong industrial background. The original members of Black Sabbath, for example, were all born and raised in Aston, an industrial district of Birmingham where the landscape, at the time of their adolescence in the 1960s, consisted of factories and wrecked buildings mostly destroyed in the bombings of WWII (Weinstein 2000: 75, 98-117; Walser 1993: 180 note 7).

Lilja identifies five main themes which the hippie culture transmitted to heavy metal: love, peace, drug, mysticism, and musical style. Love maintained its previous connection to the theme of peace, and a concrete, far more carnal dimension, mainly due to the development of contraceptives and the loosening of sexual intercourse from marriage. Peace, at least in its romantic 'Lennonian' acceptation, lost its credibility from Altamont onwards, "… a point after which the faith in the goodness of

mankind was no longer taken as self-evident – at least in rock circles". The anti-militaristic stance, especially against the Vietnam War, didn't blow over but underwent a major attitude change, clearly replacing the typical hippie philosophy of 'peace and love' with frustration and depression about mankind's evil deeds. Faith in a better world was renounced, which gave way to the pessimistic descriptive (not prescriptive) addressing of the war topic. (Lilja 2000: 26-27.) Death became a particularly celebrated topic in classic heavy metal, especially when its protagonists were the musicians themselves, e.g. B. Scott (Ac/Dc), K. Moon (The Who), J. Bonham (Led Zeppelin). It became a way of achieving immortality and a mystical aura in the memory of the fandom, and it continued the hippie rock tradition of early deceases exemplified by J. Hendrix and J. Joplin, but also by classical musicians such as Pergolesi, Mozart, Schubert, and Mendelssohn.

Mysticism, sometimes in its most dark implications, was a particularly famous topic. The bands Black Sabbath and Mercyful Fate built most of their contextual references upon Judaic and Christian-based occultism; among others, Jimmy Page and Ritchie Blackmore, two guitar heroes from the early generation, were passionate about spiritualism and séances (Page, for example, was a collector of Aleister Crowley's memorabilia) (see Paglia 2003: 57-110); also Iron Maiden and Dio used Egyptian themes later in the 1980s (Lilja 2009: 28). Walser noticed, anyway, how such use of mythological references shouldn't be taken literally:

> [All these mythological references] have certain fundamental characteristics in common, not in terms of their 'real' history, but rather in terms of their present significance. Christianity, alchemy, myth, astrology, the mystique of vanished Egyptian dynasties: all are available in the modern world as source of power and mystery. Such eclectic constructions of power, which might be usefully called postmodern, are possible only because they are not perceived as tied to strict historical context. All can be consulted, appropriated, and combined, used to frame questions and answers about life and death…. Then heavy metal surely qualifies as a religious phenomenon. But mystical metal draws upon the power of religious traditions without obeisance to any. (Walser 1993: 154.)

Cope identifies in the lyrical content of Led Zeppelin, which partly derived from the blues vocabulary, a strong misogynistic feature which in his opinion characterizes much traditional and pop heavy metal. This misogynistic and derogatory element collides with most of what was expressed by the youth culture in the 1960s about gender equality and the role of women in society.

> In other places, the lyrics of Led Zeppelin, in further drawing on the blues, frequently reflect the 'cheating woman' themes found within much rural and electric blues…. The idea of the woman as 'lyin' [sic], 'cheatin', 'hurtin'', as heard in the opening line of 'Your Time Is Gonna Come', draws on the established precepts by

> upholding the woman as 'un-natural', as challenging the subordinated aspects of patriarchal dualities – man/woman, dominance/nurturance. (Cope 2010: 75-76.)

2.2 The problematics of the analysis of vocals in heavy metal music studies

> Unlike the poïetic terms designating musical structure defined by parameters of pitch, tonality, metre and episodicity, descriptions of voice, like those of timbre, are mainly *aesthesic*. This tendency may well be due to the fact that conventional music studies have yet to establish a systematic and widely accepted poïetic terminology for vocal expression. (Tagg 2012: 344.)

Although Tagg's quote concerns music studies in general, in this thesis I focus on heavy metal music only. Academic studies about heavy metal have recognized the importance of vocals since the earliest publications: cornerstones of heavy metal academic literature, such as Walser (1993), and Lilja (2009), underline how vocals convey the lyrical message of the text, and express the characteristics of power, sonic aggressiveness and uncompromising loudness that are typical of heavy metal music. Furthermore, anthropologic and sociologic studies such as Weinstein (2000) and Berger (1999) often bestow a central role on singers, both within their bands and between bands and fans.

Nevertheless, in academic studies about heavy metal, vocals have not often been addressed from the poietic approach. This has left many open spaces to a terminology that sometimes seems contradictory among different researchers. Moreover, said terminology seems more to indicate what is the voice's impression on the listener rather than what mechanisms of voice production are used by the singers. Examples of this phenomenon can be found in studies about classic metal, e.g. the use of the term 'falsetto' by Lilja (2009) and Weinstein (2000), as well as regarding vocal phenomena typically found in the sub-genre of extreme metal, e.g. the interchangeability between the terms 'growl' and 'grunt' in Erbe (2014) or the explanation of the phonating mechanisms in Smialek et al. (2012). In this chapter, I approach more in detail one of these examples: the controversial use of the term 'falsetto' in Lilja and Weinstein.

Although this paragraph focuses on possible misconceptions about vocals in heavy metal studies, the points of criticism here expressed do not compromise the otherwise high value of such literature. I believe said misconceptions are mostly caused by inaccuracy in the use of a specific terminology about the voice. This is an important passage in my commitment as a researcher on a larger scale: I

hope to offer a more precise, practical and sharable analysis of heavy metal vocals from the poietic perspective.

A second purpose is to encourage heavy metal studies to adopt existing and ongoing scientific research vocal science; vocal science includes different clinical fields such as vocology, phoniatrics, otorhinolaryngology, logopedics, in addition to the sub-field of vocal pedagogy. The latter has partly developed into a considerable number of commercially available teaching methods. Out of these, I chose to adopt Estill Voice Training[2] (EVT) and Complete Vocal Technique (CVT) due to: a) their large and systematically organized communities of teachers in the Nordic Countries and, in the case of EVT, in a worldwide dimension; b) EVT's commitment with peer-reviewed research in voice sciences and CVT's commitment with laboratory research. As a general statement, it is probably fair to say that different singing students benefit from different approaches and methods in different, and there is probably no 'ultimate' method for teaching singing, although every one of such commercial products tries to offer as versatile and credible an image of itself as possible.

The fast-paced development of heavy metal music studies has produced a significant amount of analysis and comment on how the music is played, recorded and produced. In his argumentation about how some of the most successful and renowned guitar heroes of heavy metal had been influenced by Euroclassical music, Walser (1993: 91) extensively refers to the most common electric guitar techniques, explaining how they are notated in tablatures and keenly transcribing virtuosic solos from successful songs by Van Halen, Randy Rhoads and Ritchie Blackmore. Lilja (2009) offers a great number of musical transcriptions from guitar and bass riffs, including also some notation marks, such as legato or harmonics, which belong to the technical vocabulary of those instruments. Cope (2010: 96-103) analyzes the influence of drum patterns in shaping the change from traditional to extreme metal during the 1980s.

These examples show how the instrumental techniques involved in making heavy metal music have raised an undoubtable interest in many a scholar. Such cases present a type of analysis that focuses on how sounds are produced and combined together. Quite often, they also use technical vocabulary pertaining to the specific instruments, and Walser's abovementioned table is a very fitting example in this respect. Some of them even explain many of the reasons why certain instrumental techniques prevailed upon others, as Lilja does with his discourse on the acoustics of power-chords.

[2] Named after Jo Estill (1921-2010), an American singer and pioneer of the singing voice research. "Her insights led to the development of the Estill Voice Model™ […] also known as Estill Voice Craft™" (McDonald Klimek et al. 2009a: 1).

The poietic aspect of vocals has been studied less frequently in the heavy metal academic community. Walser and Lilja, for example, mention vocals but mostly refer to what role they play in the overall sound, or what aural characteristics they usually possess compared to the canons of the genre. Moore (2012) addresses vocals in the recorded popular song from the points of view of semiotics, expression and authenticity. A similar perspective is also adopted in Berger's ethnographic work (1999), part of which engages with the musical practices of a death metal band in Ohio. Although these approaches offer thorough insights on what the listener perceives in the singers' voices (e.g. power, loudness, the sound being piercing), they only deal very briefly, or not at all, with how said voices are produced, or what – in the way of singing – differentiates certain sonorities from others.

A poietic perspective has been adopted in a clinical study by Sakakibara et al. (2004) about the use of growl voice in ethnic and pop singing. In this study, which mentions heavy metal only as a side concept, growl seems to be akin to what Mesiä & Ribaldini (2015) identify as 'grunt'. Eckers et al. (2009) conducted another clinical study on six different death metal singers. This study shows how, though sharing some primary characteristics, the six singers produce extreme distortions of their voices in slightly different ways from each other. Smialek et al. (2012) analyzed extreme vocals from an acoustic perspective through the aid of spectrograms. This study, which comes from within the field of heavy metal academia, presents a short section about the poietic aspects of such vocals, although later in this chapter I argue that such explanation of vocal mechanisms might not be completely accurate. Smialek (2015) further expanded on the same topic in his doctoral dissertation about genre and expression in extreme metal.

Of the studies here mentioned, only Eckers et al. and Smialek et al. specifically address heavy metal. Eckers et al. employ a clinical perspective from vocal science and deal with a poietic aspect, whereas Smialek et al. deal with an acoustic perspective. Furthermore, all the abovementioned studies focus on extreme metal vocals. In heavy metal academic studies, non-extreme vocals are even less frequently addressed.

2.2.1 The particularities of a musicological analysis of the singing voice

In popular music – including heavy metal – vocals usually play a slightly different role than the rest of the 'standard' instrumentation (by 'standard' I here mean electric guitar, bass, drums, and sometimes keyboards). As an instrument, the singing voice is also tied to each individual singer, a

particularity that requires additional care when scientifically approached. Here, I summarize some elements that make the analysis of vocals more challenging.

First and foremost, the sonic dimension of the voice shares similar fundamental characteristics with other instruments, e.g. pitch, duration, attack, envelope, phrasing etc. (Tagg 2014: 31-37). Furthermore, vocals can be analyzed through music theory, for example considering what role they play in the harmony, what is the melodic line, what rhythmic patterns they follow, etc. At times, vocals are used purely 'as an instrument' instead of conveying lyrics, as it is at the beginning of "Immigrant Song" by Led Zeppelin (1970) or "Holy Diver" by Dio (1983), where the voice sings a wordless melody; vocals without words can also be semiotically very strong, for example in the form of a horrified screech in Iron Maiden's "The Number of the Beast" (1982).

One of the main problems with analyzing vocals, and not only vocals nor only in heavy metal, is the absence – in the standard western mensural music notation – of a collection of signs specifically describing the singer's performance. After World War II, several classical composers created their own sign systems for music notation, instead of referring to standard scores. They did so in order to indicate with enhanced precision how musicians, singers included, should perform, and also in order to indicate sounds which were not generally used in earlier Euroclassical compositions. Good examples of this tendency are Crumb, Grisey, and Lachenmann. Standard notation, though, was still employed by composers such as Strawinskij, Schönberg, R. Strauss, Prokof'ev, and many others. In the context of popular music, where not all musicians were proficient in reading the (sometimes very complex) standard Euroclassical notation, and where the individual's interpretative freedom had much more space than in the world of classical music, lead-sheets became the preferred method to write songs down on paper and publish them in so-called 'fake books' (Kernfeld 2003). An example is given in Figure 2.1.

In popular music, guitar and bass find in tablatures an alternative notational method which – although being itself not completely sufficient – can be combined with the standard one to describe the practice of such instruments more precisely. An example is the explanation table for guitar tablatures symbols given by Walser (1993: 91) and reported in Figure 2.2. Walser himself cites the picture from an August 1990 issue of *Guitar for the Practicing Musician*.

Figure 2.1 - An example of lead sheet

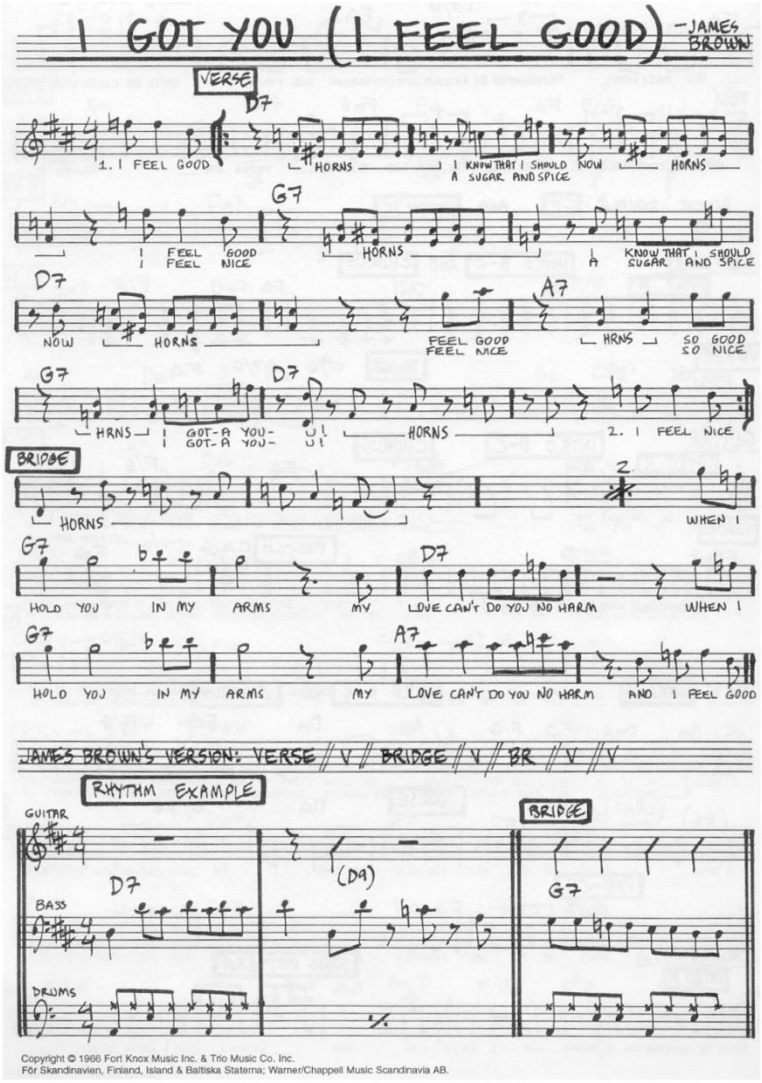
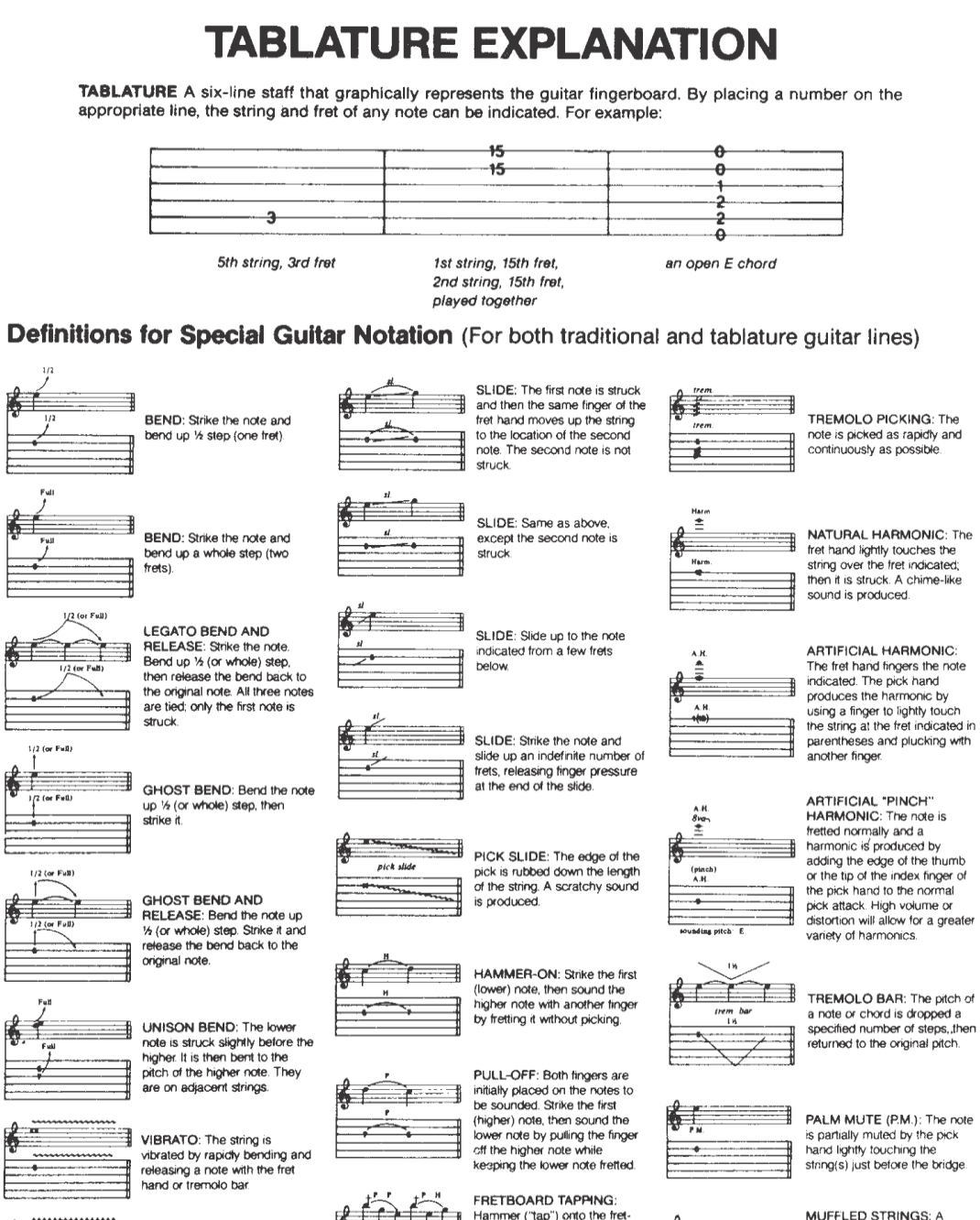


Figure 2.1: An example of typical lead sheet. (Fort Knox Music Inc. 1966)

Figure 2.2 - Tablature explanation by Walser



Example 11. "Tablature Explanation and Definitions for Special Guitar Notation" (From *Guitar for the Practicing Musician*, August 1990, p. 33. Copyright © 1992 Cherry Lane Music Co., Inc. International Copyright Secured. All Rights Reserved. Reprinted by Permission of Cherry Lane Music Co. Inc.).

Figure 2.2: Table of explanation for symbols in guitar tablatures. (Walser 1993: 91)

Even though tablatures themselves are not completely accurate (and can't represent the nuances of a performance in full), they are arguably more exhaustive than what standard notation, exemplified in Figure 2.1, communicates about the singing voice. Usually, the notated vocal part indicates the pitches and rhythm of the melody as well as the lyrics, but it gives no hint about e.g. what vocal register should be preferred, how high the singer's larynx should be, vocal effects, and so forth (these concepts are elaborated on in §4). This creates small problems to the performers themselves: they can rely on their own personal interpretation, the genre canons, their aural ability in case they try to mimic someone else's singing, and oral communication in case a second person tries to obtain a specific sound from their voice, such as in the case of a producer giving directions in the studio, or a bandmate advising the singer on the way to perform a certain passage.

For a scholar who wishes to describe what happens in a vocal performance, standard music notation would probably need to be integrated with other descriptive tools. A possible one is plain text, for example "in bar 54, on the word 'Satan', the singer uses a distortion". Specific words about vocals, such as 'vibrato', 'distortion', 'twang', etc. could be integrated as staff text instead of being written in plain text. While this method would probably be of great help with descriptive analysis, it might be more challenging to adopt as a prescriptive one for performers, since the written information on the text might become somewhat chaotic. Methods of description through graphic representation, such as e.g. spectrograms, could indicate e.g. timbre and rhythm feel. Nevertheless, they would be probably challenging for performers to adopt, and their common use instead of standard notation seems unrealistic. One the other hand, it is true that most musical practices widely rely on a complex and stratified heritage of techniques and interpretative habits which escape music notation, and which are usually transmitted in either oral or written form. It seems fair to summarize that performers and describers of the music use different tools to represent vocals on paper, and while such tools respond to different purposes, there seems not to be an equally effective common one.

Whereas foreign body -instruments such as guitars, drums or keyboards can be traded and exchanged among musicians, singers' voices are inevitably tied to individuals and to their vocal apparatuses. It can be argued that the same guitar, if played by two different guitarists, produces a different result because of the individual touch, playing technique, musical taste, and so on. But it is still the same guitar and retains certain characteristics of its own, which do not depend on who is playing it. A singer cannot swap their phonating apparatus with another singer's, and quite often even the same voice works slightly differently in different moments depending on the weather, the singer's physical condition and age, the time of the day, and many other factors. For example, the phonating apparatus

of the same individual works differently at a young and an older age, and the voice might sound different as well. This – although it does not completely prevent the possibility of a comparative approach to vocals – makes it even more difficult when moving in a scholarly and scientific environment: every possible comparison and general discourse is, at some point, bound to give way to the unique characteristics of each individual voice. To an aural analysis, voice imitators are able to achieve a high degree of resemblance to their target voices, but studies by Zetterholm (2002) and Iwano & Horihata (2016) report controversial result on the actual acoustic similarity between imitated voices.

Furthermore, most of the vocal apparatus is inside the singer, therefore difficult to be seen directly in action. Clinical explorative exams such as laryngoscopy, videokymography and videostroboscopy have greatly helped with the development of a scientific discussion about the operational principles of the singing voice. Nevertheless, these technological aids are not easily accessible and, to some extent, their invasiveness limits what singers can demonstrate when having the laryngoscope or other instruments inside their nose or throat. Although this does not prevent scholars from applying aural analysis on a vocal performance, it makes more challenging to study certain aspects of the voice from a clinical and poietic point of view. Moreover, so far there only is a handful of cases of traditional rock or heavy metal singers lending themselves to a public exploration of their voices, the most widely known exception being Steven Tyler from Aerosmith appearing with a laryngoscopy of his vocal folds on the National Geographic TV film *Incredible Human Machine* (2007).

It is not particularly clear how well heavy metal singers from the first generations of heavy bands (approximately 1970-2000) knew the mechanisms of singing when they indirectly established the canons of vocal practices in heavy metal with their own performances. While the recent history of heavy metal offers examples of singers who took vocal lessons (e.g. Angela Gossow, Corey Taylor) or even graduated from institutions of music education (e.g. Tarja Turunen, Timo Kotipelto), the situation was probably different in the early days of heavy metal. Modern singing pedagogy started to develop only around the 1980s, although the vocal science on which it was based had already been existing for a couple of decades (with the work of e.g. Minoru Hirano, Richard Miller and Harry Hollien). Older heavy metal singers might have taken vocal lessons or collected more scientific information about their instrument later in their career: for example, Blackie Lawless from WASP revealed that, in 1983, he was able to recover from serious vocal health problems with the aid of a specialist doctor (YouTube 2014). Still, early heavy metal singers' knowledge of vocal science and vocal pedagogy remains unclear, and a generalization seems too hazardous. Although this may not

be a critical obstacle, it makes a possible first-hand opinion exchange in scientific terms between scholars and performers more complicated, if not even misleading.

The difference between live performances and studio recordings affects our perception of vocals on record and live. This topic has been scrutinized by e.g. Clarke (2002), Johnson (2002), Moylan (2012), Frith (2012), and Schmidt Horning (2012). In popular music, the studio recording has long since been a fertile ground for the intervention of sound editing technology, at first in the analog age, then in the digital one. Although the degree of editing in post-production varies from case to case, quite rarely what is heard in a studio album mirrors a live performance: over-dubbing, multi-take recording, cutting and pasting, harmonizing, mixing, and digital pitch correction[3] are used to obtain on record what a singer could not do in a single top-to-bottom take. Even so-called 'live albums', i.e. albums consisting of recorded material from one or more live shows, are often mixed and edited as if they were studio albums, although the possibilities of editing intervention are more limited (a performer cannot, in fact, retake a section of the song, at best that section can be borrowed from a different recorded show and blended into the song mix). On the other hand, basing aural analysis solely on unedited recordings of live performances would be difficult, since unofficial recordings from live shows made by e.g. fans ('bootlegs') are usually forbidden by copyright laws. When relying on official releases (studio and live albums), it is recommendable to remember that they mostly sound different than the unedited singer's voice.

2.2.2 Controversial terminology and misconceptions in previous analyses of heavy metal vocals

In heavy metal studies not specifically dedicated to vocals, the latter are often a minor sidetrack of the primary discourse. The following points of criticism do not mean to compromise the otherwise fundamental value of those researches, being it music-analytical, historical, sociological, semiotic, or else. Said points only intend to encourage the adoption of a more refined technical vocabulary regarding vocals, and hopefully a source of clarification within a field – that of singing in heavy metal – that would certainly benefit from deeper inquiry.

[3] Pitch correction was possible – to a certain extent – already before the age of digital recording. Nevertheless, since the 2000s, the frequent digitalization and re-mastering of heavy metal albums from the pre-digital era has in fact produced a retroactive wave of digital voice editing even on old records.

Walser's (1993: 45), Weinstein's (2000: 26-27) and Cope's (2010: 127-133) texts exemplify how the analysis of vocals in heavy metal often focuses on its semiotic and dramatic characteristics. As an exception, Lilja provides notated transcriptions of vocal melodies (2009: e.g. 53, 96, 98, 100, 164-165, 170-171). His point of view, though, mostly focuses on the role of the melodic line in the broader context of the harmony (of either the single riff or the song). When said studies address the poietic aspect, their use of technical terminology does not always match that of vocal science. For example, Walser states that:

> The vocal sounds of heavy metal are similar, in some ways, to the guitar sounds. Quite often, vocalists distort their voices, for many of the same reasons that guitar players distort theirs. Heavy metal vocalists project brightness and power by overdriving their voices (or by seeming to), and they also sing long sustained notes to suggest intensity and power; sometimes heavy vibrato is used for further intensification (Rob Halford of Judas Priest is a prominent example). The tough solo voice, the norm of vocal delivery, is occasionally supplemented by a chorus of backup voices, most often during the chorus section of the song. These additional voices serve to enlarge the statements of the solo vocalist, enacting the approval or participation of the larger social world, or at least a segment of it. (Walser 1993: 45.)

In heavy metal, voices are indeed sometimes distorted: distortions of different kinds are expressive tools that singers commonly use in heavy metal as well as in other styles, even though they are not a necessary feature of the genre. Ronnie James Dio, for example, used to add distortion to his singing very often, whereas other successful singers such as Rob Halford, Ian Gillan and Ozzy Osbourne used such expressive tool more rarely. It is also reasonable to think that, given the overall sonic context of power, loudness, amplification and distortion provided by the rest of the instrumentation, early heavy singers tried to adjust the sound of their voices accordingly. The term 'overdriving' indicates a relationship between power and distortion. In general audio signal processing, it indicates an excess of input from the source, which causes the signal to be distorted (White & Louie 2005: 274-275). When Walser refers to overdriven vocals, he does not clarify how this overdriving process occurs. Excess of input at source level in singing implies an excess of air pressure under the true vocal folds (Mesiä & Ribaldini 2015: 386), which is not a successful long-term strategy for phonation. If what Walser means is that singers distort their voices, this effect can be achieved in multiple ways, but they relate more often to modifications of the vocal tract than to a real excess of source input (Mesiä & Ribaldini 2015: 389). Furthermore, the projection of power and brightness is not exclusive of distorting the voice, but also achieved by singing in a high range and with vocal effects or technique that enhance middle and treble frequencies, e.g. 'twang' or 'belting'.

Twang is an effect aimed to enhance the frequencies of the voice comprised between 2-4 KHz, therefore producing a more piercing and metallic sound. Both Estill Voice Training (McDonald Klimek et al. 2009a: 87-89) and Complete Vocal Technique (Sadolin 2012: 51-52), although with minimal differences, describe twang as obtained by narrowing the upper part of the larynx through a backward tilting of the epiglottis and a slight forward tilting of the arytenoid cartilages.
Belting is a high-intensity technique mainly used in musical theatre, gospel music, and sometimes in rock, heavy metal and Euroclassical singing, in order to make the sound more projected. Belting is often perceived as a loud shout, and in musical theatre belted tones often mark the climax moments of a song. It results in a very loud sound. Estill Vocal Training used to identify in a backward tilting of the cricoid cartilage the key mechanism of belting. (McDonald Klimek et al. 2009b: 65-76; Sundberg, et al. 2012; Sundberg & Thalen 2015.) This conception has been recently put under criticism, e.g. by Kayes (2017), although it remains clear that the origin of the belted sound is a thicker and longer closure of the true vocal folds, in addition to a stronger subglottal pressure.
The vocal technique of vibrato is very common in any music genre, and it is not merely employed in order to obtain an intensification of the sound, but for a variety of purposes which sometimes include creating smooth diminuendos, such as for example after a long powerful tone (Sundberg 1994). Twang, belting and vibrato are explained more in detail in §4 of this thesis.

Lilja's overview on the topic aims to find correspondences in the style of singing between early heavy metal vocalists and singers from other genres:

> Vocal style is generally high pitched tenor, frequently employing falsetto. Still, there are exceptions to the rule; […] Deep Purple's Ian Gillan and Led Zeppelin's Robert Plant clearly derive much of their vocabulary from blues and rock 'n' roll. For instance, Gillan's singing in "Speed King" (In Rock 1970) significantly resembles the gospel-influenced vocal style of Little Richard; […] Both Gillan and Plant use a lot of vocal embellishment that is common in gospel-derived styles (cf. e.g. Ray Charles, Sam Cooke) and various forms of the blues (e.g. Robert Johnson, Billie Holiday). (Lilja 2009: 36.)

Examples like David Coverdale, Ronnie James Dio, Ian Gillan, Robert Plant, and Glenn Hughes, support Lilja's statement that early heavy metal singers consistently borrow licks and melodic embellishments from blues, rock and roll, and gospel music. When mentioning falsetto, Moore (2012: 104) also presents a similar conception to Lilja's. Being Lilja's work primarily focused on music theory, it is no surprise that he focuses on what influences the singers' melodic lines. On the other hand, Lilja's reference to the technical aspect of singing could benefit from a more precise vocabulary.

Firstly, he addresses the tenor voice as a style of singing, as if it were possible to choose whether to adopt it or not. In fact, the term 'tenor' refers to a type of male voice whose characteristics are almost solely based on the physiological structure of the singer (Mürbe et al. 2011; Roers et al. 2009). In Euroclassical music, a voice type is determined by certain characteristics such as range and quality of the timbre. Tenor is the male voice type with the highest range; the other two commonly used male voice types are baritone (middle range) and bass (lower range). The three main female voice types are, from highest to lowest, soprano, mezzo-soprano or mezzo, and contralto or alto. In the Euroclassical singing tradition, there is a rich catalogue of other more nuanced denominations, e.g. baritenor, heldenbaritone, tenore di grazia, dramatic bass, which refer to the specific repertoires where such sub-types work at their best. Since this system of classification was originally devised for Euroclassical repertoire – particularly for opera – its suitability to non-Euroclassical singing has been an object of controversy for a long time, with some singing teachers avoiding it altogether and others adopting it loosely. Being this topic of mild relevance in this article, I would not venture here in ultimately aligning with either of the two options. I here point out that a singer sings in a tenor voice because his physiology is the one of a tenor, in the opposite case he does not, and it is not a matter of choice or style (Mürbe et al. 2011; Roers et al. 2009).

Furthermore, it is not univocal whether Lilja considers falsetto a vocal style or something else. Indeed, heavy metal singers sometimes use falsetto (as singers do in most other musical traditions, including Euroclassical), but in this specific context the term needs further clarification and its use might originate misunderstanding. Unlike being a tenor or not, the use of falsetto can be chosen by the singer – if the latter is able to use it – since it is a particular register, that is, according to Titze (2000: 282) a "perceptually distinct region of vocal quality that can be maintained over some ranges of pitch and loudness". In other words, it is an area of the voice where the latter is produced by the vocal folds in a consistent way and sounds alike. Changing the setting of the vocal folds usually changes the register as well, and such changes can be generally aurally recognized. Registers are explored more extensively in §4.1.

Another possible misunderstanding in analyzing vocals is to bestow technical evaluations on the voice moving from the lyrical content. For example, Pillsbury (2006) seems to create a direct connection between the high-pitched singing and the idea of the pharaoh's power in the song "Curse of the Pharaohs" by Mercyful Fate (1983).

> ["Curse of the Pharaohs"] relies on wide-ranging chromaticism and lead singer King Diamond's piercing falsetto to project the idea of the pharaoh's power. (Pillsbury 2006: 121)

As pointed out by Lilja (2016), King Diamond's vocals in this song are not wide-ranging, and they are similar to King Diamond's vocal style in most of his production, not only in the songs about pharaohs. Furthermore, according to the definition of falsetto I will address more extensively in §2.2.3 and §4, King Diamond does not use this vocal register here. Although his sound is indeed sometimes piercing, falsetto is not very suitable to produce a sound with such characteristic. Therefore, it is well possible that King Diamond sings piercing sounds as well as uses falsetto in different moments of "Curse of the Pharaohs", but these two options cannot be simultaneous.

Weinstein's *Heavy Metal* (2000) approaches vocals with a particular attention to the social and symbolic role of the singer.

> The heavy metal vocalist is an individual and is not submerged in a vocal group. But the singer is also embedded in the band; […] The heavy metal code for the singer is distinctive. One major requirement is the explicit display of emotionality, which contrasts with the punk vocal principle of the flat, unemotional voice. But not all methods of emotional display are permitted. The plaintive, nasal whine of country music and the falsetto of doo-wop are rejected. The singing is openmouthed, neither gritted nor crooned. The range of emotions is wide, including pain, defiance, anger, and excitement. As in other features of the genre, softness, irony, and subtlety are excluded. […] The heavy metal singer's voice must also sound very powerful. It is amplified not merely by electronic devices, but by a robust set of lungs and vocal chords [sic]. Special sounds, especially screams, serve to emphasize the power and emotionality of the voice. Led Zeppelin's Robert Plant and Judas Priest's Rob Halford are well known for their wails and yowls. […] Other singers use an operatic voice, although it cannot be pure toned. There must be a blues-tinged toughness in the voice. Ronnie James Dio's voice […] is an example of this gritty-operatic option. (Weinstein 2000: 26-27.)

Weinstein seems to dismiss the fact that punk vocals usually aim to deliver anger and frustration, therefore addressing the punk vocal style as flat and unemotional might be a questionable choice of terms. To me, it sounds more realistic to say that, in punk, vocal melodies are not very clear and varied, and the types of voice are often much closer to yelling rather than melodizing. Classic heavy metal singers do not exclude either gritting, 'crooning', or singing their lines open-mouthedly: Ian Gillan, for example, 'croons' the lower parts in Deep Purple's "Child in Time" (1970), but opens his mouth and powerfully hits the high notes at the end of the vocal climax in the same song. Singers might privilege one particular delivery style over the others, but it would be daring to say that any of such styles is completely left out. Similarly, excluding softness, irony, and subtlety, as Weinstein

does, seems to fit the fastest and most aggressive heavy metal repertoire, but does not consider power-ballads and quiet parts of otherwise sonically aggressive songs, e.g. "Victim of Changes" by Judas Priest (1976), which presents a complex and varied structure. Whereas common sense suggests that the physical characteristics of the average heavy metal singer's vocal apparatus must match the power of the sound, it is not necessary to be equipped with either extraordinarily strong lungs, or thick vocal folds. Tenors usually have the smallest vocal folds among male voices, and the amount of breath inhaled when singing pop/jazz music is only a minor part of the maximum capacity. (Mesiä & Ribaldini 2015: 385-386.) Operatic voices belong to the Euroclassical tradition and, aside from rare exceptions (e.g. former Nightwish vocalist Tarja Turunen), are very uncommon in heavy metal canons. Many characteristics of the other instrumental parts indeed owe a lot to the Euroclassical practices, but vocals do not borrow much from this repertoire. The definition of 'pure toned' might be misleading, since in popular music the standard of pureness and cleanness of the vocal parts is more blurred than in the Euroclassical tradition, and the individual singer's timbre may be characterized, for example, by breathy or raspy sound, slightly off-tune ornaments imitating blue-notes, and so on. Finally, although blues singing is one of the major inspirations of heavy metal vocalists, not all of them borrow from the same musical tradition. Ronnie Dio himself, though very much influenced by blues when singing in the bands Elf and Rainbow, uses blues tones or swinged rhythms more rarely in his later career with Black Sabbath and his self-named band. It seems quite contradictory, then, to describe Dio's voice as 'operatic-gritty', when the two types of sound present opposite characteristics, as more extensively discussed in §4.

The enormous interest raised by extreme metal vocal techniques has brought heavy metal studies to deal with the matter. Smialek et al. (2012) conducted an innovative study on the measurement of extreme metal vocal sounds with the aid of spectrograms and formant analysis. According to their overview on the mechanisms of voice production:

> To produce the vocal sounds characteristic of death metal and black metal (as well as related sub-genres), extreme metal vocalists pass air through the *ventricular folds* (or "false vocal chords") located a few millimetres above the vocal folds. This allows extreme metal vocalists to achieve the large spectral spread of energy visible in spectrograms. Extreme metal screams can be performed by either inhaling or exhaling, resulting in two very distinct styles of screaming. The different directions of air flow can be thought of as akin to the linguistic distinction made between voiced and unvoiced methods of articulating consonants: when performing exhaled vocals, one's larynx vibrates, indicating that the vocal cords are vibrating—rather forcefully—whereas this vibration does not occur with inhaled vocals. This basic difference has a profound effect on the overall sound

> quality produced, the ease with which different phonetic articulations can be made, the ability for a vocalist to sustain a long scream, and the degree of strain put on the voice. (Smialek, Depalle and Brackett 2012: 88.)

From this excerpt, one would assume all extreme vocal techniques pivot around the passage of air through the ventricular folds. According to Eckers et al. (2009), extreme metal vocals are not only nor always produced by the activation of these laryngeal structures: the little amount of research thus far conducted in vocal sciences seems to indicate that various structures usually participate in producing turbulence above the true vocal folds level. In addition to the ventricular folds, the arytenoid cartilages, the aryepiglottic fold, the epiglottis, the uvula and the pharynx partake in producing a variety of vocal sounds commonly used in extreme metal (see also Complete Vocal Institute 2017). The vibration of the larynx is not strictly connected with inhaled or exhaled vocals, but rather with the amount of involvement of the true vocal folds in the phonation (for more extended insights about inhaled phonation in general, see Orlikoff et al. 1997). Exhaled phonation, even in extreme metal vocal techniques (such as grunt) can present a rather small vibration of the true vocal folds, and in general vocal folds vibration is not particularly more forceful than in normal phonation (Eckers et al. 2009).

Is a unified terminology on vocals necessary in heavy metal studies? The variety of terms used by musicians, metal fans and journalists (or other media intermediators between the artists and the audience), seems to advocate for a negative answer. These agents often call the same thing in different ways, or they refer to different things with the same word. An example is the range of denominations referred to extreme metal vocals: ‘growling’, ‘grunting’, ‘screaming’, ‘squealing’ are all associated with the vocal practices of extreme metal singing. Extreme metal musicians, fans, media and scholars often refer to these terms with different meanings, both across the communities and within the individual communities themselves. When referring to vocals, some of these groups prioritize other focal points than the terminological precision about the poietic aspect, e.g. the emotional response generated by the voice, the message conveyed by the lyrics, the sonic blend of vocals and other instruments, and the mental images associated with the vocalist’s performance. When focusing on the poietic perspective, especially in non-academic environments, the preferred terminology usually avoids technicalities and too specific explanations. Thus, the mechanisms according to which vocals are produced are often left out of the discourse. I believe that the integration of knowledge from vocal science into this discourse would enhance the latter’s precision and specificity: despite some internal discrepancies in frontier research topics, vocal science guarantees a solid basic methodologic

structure address the singing voice by its physiological and poietic aspects, instead of considering only the artistic and aesthesic ones.

In a non-academic environment, leaving the discourse free from too many terminological constraints probably has positive sides. While a scientifically precise vocabulary would perhaps smoothen and make more consistent the interaction between different agents within the music milieu, encouraging the spreading of such knowledge and precise terminology would probably require a long time and a ponderous effort, and might risk to take away part of the 'magic' that heavy metal music and its narratives are able to offer to the communities involved with it. In academic studies, though, I believe presenting a solid and somewhat easily relatable terminology produced by vocal science would create a more uniform discussion within the community of researchers dealing with heavy metal studies. Next, I exemplify this necessity for a common terminology through the case of the controversial use of the term 'falsetto' in Lilja and Weinstein.

2.2.3 Two exemplifying cases

Both Lilja and Weinstein address falsetto, but they arguably refer to different vocal elements. Lilja uses the word in the same context with the 'high-pitched tenor voice', but he does not explain any further what falsetto consists in; in addition to that, a few sentences later Lilja refers to falsetto singing as 'piercing' when speaking about Uriah Heep's keyboardist and vocalist Ken Hensley.

> Vocal style is generally high pitched tenor, frequently employing falsetto. Still, there are exceptions to the rule; Uriah Heep's lead vocalist David Byron usually stays within lower baritone pitch and leaves the piercing falsetto singing to the organist Ken Hensley. (Lilja 2009: 36.)

From the vicinity of the two concepts, it seems Lilja understands falsetto as a high-pitched area of a singer's vocal range, where the sound is piercing. Weinstein, on the other hand, seems to understand it differently:

> [In heavy metal] one major requirement is the explicit display of emotionality […] But not all methods of emotional display are permitted. The plaintive, nasal whine of country music and the falsetto of doo-wop are rejected. (Weinstein 2000: 26-27.)

Doo-wop is "[a] style of vocal rock and roll popular in America in the 1950s and early 60s. It was essentially an unaccompanied type of close-harmony singing by groups of four or five members; if an accompaniment was added it functioned as a restrained background, largely obscured by the voices." (Rockwell 2016.) According to another definition, it is "the variety of often onomatopoetic vocal phrases that various back-up singers executed in syncopation with their lead singers. The type of vocal harmony group historically associated with the genre was predominantly urban in origin and African American in composition." (Sanjek 2016.) Associating falsetto with the music style of doo-wop suggests that Weinstein's understanding of such vocal register is connected with lightness and delicacy. This is further confirmed by her idea that falsetto is not a most suitable manner of emotional display in heavy metal, where – according to Weinstein herself – the display of emotionality must be explicit and, according to Walser (1993: 2-3, 9), power, loudness as well as sonic aggressiveness are among the key qualities of the genre.

Here, understanding the same term in different ways originates almost opposite conceptions. Lilja suggests that falsetto implies power and high pitch, whereas Weinstein's idea does not mention pitch but refers to a delicate, low-effort way of singing. So, in the former case falsetto is considered very appropriate and widely used in heavy metal (although Lilja mentions that there are exceptions), whereas in the latter it does not fit in such a generally loud genre because of its lack of power, therefore it must be rejected along with 'milder' emotions such as "softness, irony and subtlety" (Weinstein 2000: 26). Both the approaches seem to move from the aural appreciation of the vocal phenomenon in question, and not from the way it is produced.

Concrete examples of both Lilja's and Weinstein's conception of falsetto can be found in the singing performance of Ian Gillan in Deep Purple's "Child in Time" (1970). A separated vocal track of this song is available on YouTube (2012). The first of these examples more or less matches Weinstein's description. Around 1'55" of the studio version, after the last words of the initial verse, Gillan starts a descending melody on the vowel [u], which begins with ĉ5 (in International Pitch System), as shown in Figure 2.3.

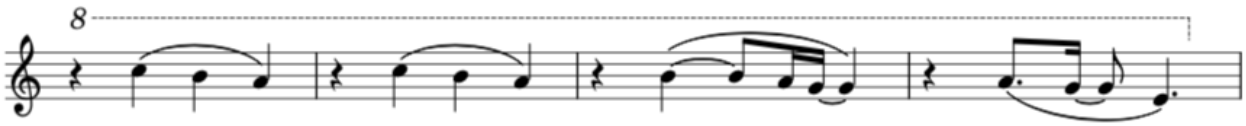


Figure 2.3: "Child in Time", example of falsetto according to Weinstein's understanding, ca 1:55

Gillan's voice sounds quiet, effortless and slightly breathy. The vocal track is overdubbed (recorded twice), probably in a place with a fair deal of natural reverberation. His falsetto sounds distinctly breathy in the lower range, while breathiness is less clearly recognizable in the middle and high ranges, because – generally speaking – the higher pitch goes, the more the vocal folds stretch and the gap between them (called 'glottis', see §3.2) becomes narrower. In addition to this, the vocal tract above the true vocal folds shrinks. Therefore, in a high pitch range falsetto might be aurally confused with head register (see §4.1.2).

Weinstein's conception of falsetto seems closer than Lilja's to what is generally recognized as falsetto by vocal science (see §4.1.3). The second example from "Child in Time" presents a powerful and piercing sound, which is closer to Lilja's conception, although it is not falsetto according to most vocal science, which on the contrary supports Weinstein's idea. Figure 2.4 shows a different descending melody sung by Gillan at 2'37", where the starting and highest tone is â5.

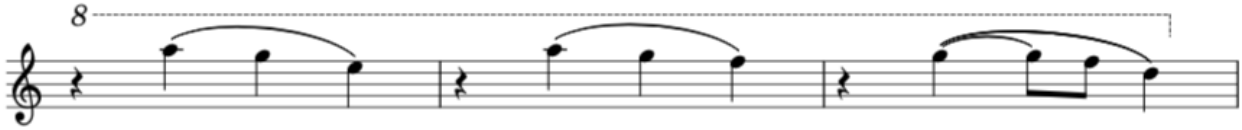


Figure 2.4: "Child in Time", example of falsetto according to Lilja's understanding, ca 2:35

The voice volume is higher here, and it is aurally possible to understand that the phonation is more energetic and powerful than in the previous case. Lilja arguably refers to this kind of phonation when he speaks about falsetto, although this voice quality is not falsetto, but rather a different register called 'high modal' or 'head register' (see Mesiä & Ribaldini 2015: 390). Here, the vocal folds are closely

connected, and the glottal configuration is characterized by high air pressure and small air leakage at the vocal folds level. In order for the produced sound to consistently maintain its sustained power through long notes, the very high subglottal pressure needs to be counterbalanced by a similarly high supraglottal pressure, that is the pressure above the vocal folds (Kochis-Jennings et al. 2012; Kochis-Jennings et al. 2014). When aurally trying to trace the sound back to its way of production, this increase of supraglottal pressure is here presumably obtained by adding aryepiglottic twang effect (see §4.2.2). Another way to increase pressure in the vocal tract is to lift the soft rear part of the palate, which Gillan may do in this case (aural analysis does not clarify). This vocal configuration is noticeably different from the one Weinstein refers to, and from falsetto as defined in vocal science as well. Figures 2.5 shows a schematization of the difference between falsetto and head voice.

Figure 2.5 - Vocal folds configuration in falsetto and head voice

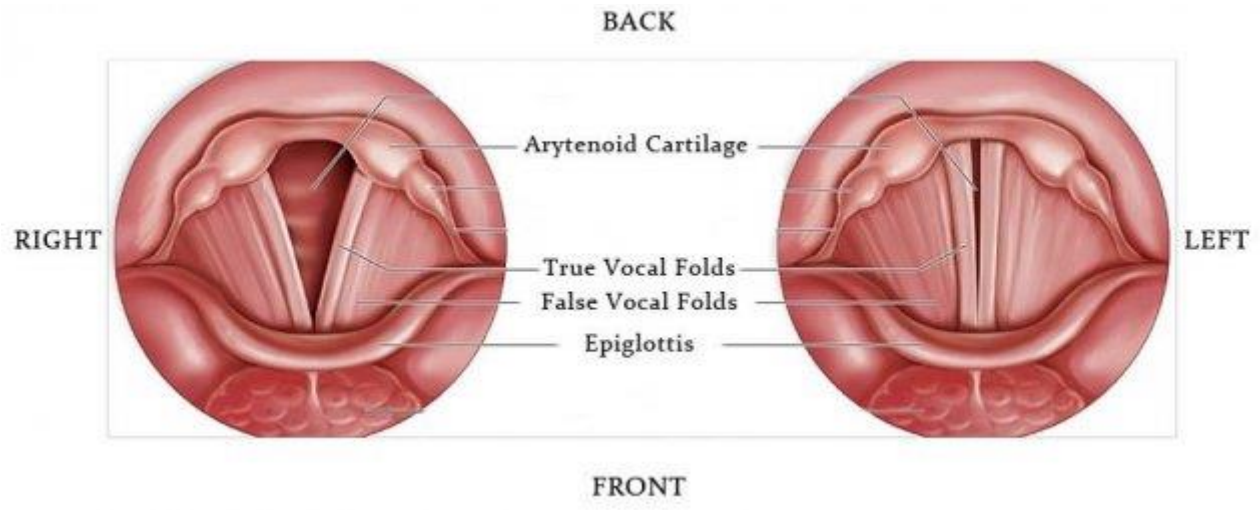


Figure 2.5: Difference in the configuration of the vocal folds between falsetto (left) and head voice (right). The writings 'front', 'back', 'left' and 'right' on the picture indicate the orientation of the singer. (Adapted from RamseyVoice 2019)

2.2.4 Integrated outer sources of knowledge about heavy metal vocals

The way the singing voice works is very complex, as exposed in the previous paragraph. For many centuries, scientists have tried to unveil the mysteries of the voice from a great variety of perspectives, which conveyed in the vast academic field of vocal science. The latter includes, for example, the disciplines of vocology, phoniatrics, otorhinolaryngology, logopedics, and vocal pedagogy.

A rapid expansion of the medical research on phonation took place after the Second World War. From the 1970s onwards, a growing scholarly community has concerned itself with singing in a dimension of quantitative measurability and explored many of the functioning mechanisms of the voice. Worth mentioning here are e.g. Minoru Hirano, Ingo Titze, Jo Estill, Johann Sundberg, Jan Švec, D.G. Miller, and Harry Hollien. Surely many more could be added to this list. Vocal pedagogy started to include these multi-disciplinary approaches as well. As a result, music conservatories, universities and academies, specialized in either Euroclassical or popular music education, nowadays propose singing teaching based on methods derived from vocal science. Nevertheless, the scientific exploration of the singing voice is far from being at its final stage: on the contrary, it continuously develops and challenges itself, also thanks to more and more advanced research tools such as, for example, microscopic instruments for laryngoscopy. Vocal pedagogy, as well as most teaching methods for singing, also participates in this development.

It is my conviction that heavy metal studies could undertake a multi-disciplinary approach to vocals by integrating the terminology offered by vocal science. Such integration would provide researchers in heavy metal music with a shared vocabulary about the voice, as well as shared knowledge about the physiological mechanisms that regulate voice production. Furthermore, it would reduce the possibility of misconceptions about said mechanisms. Mesiä & Ribaldini (2015) offer a brief example of how such integration is possible by implementing the knowledge and terminology offered by vocal science, in order to categorize the most common vocal elements used by singers in heavy metal music practices. Nevertheless, its limited length calls for more expanded and specific work towards this goal. Next, I will expand this integration and apply it to a more practical analysis.

3 An introduction to the physiology of singing

Before providing the reader with a specific terminology through which singing may be aurally analyzed, the basics of the physiology of singing need to be previously discussed. Understanding how different sounds are produced, and what are their primary aural characteristics, helps to identify different singing phenomena. This chapter aims to provide a simple explanation of how the human singing voice works. Due to the complexity and vastness of the topic, I here explain it in general terms and in a possibly manageable way even for a reader with no previous knowledge about the voice. My purpose is to offer not a comprehensive handbook of voice physiology, but rather a simple and relatable toolkit to develop a shared base-level knowledge of vocals in heavy metal music. For a more complete, specific and detailed description of vocal mechanisms, see fundamental works from the fields of vocology and phoniatrics, such as e.g. Merati & Bielamowicz (2007), Titze (1993; 2000; 2008), Titze & Verdolini-Abbott (2012) and Sataloff (2013). Although the literature is extremely extensive, I chose to refer primarily to the three decades-long work of Ingo Titze because of his internationally recognized influence and fundamental contribution to the field of vocology.

3.1 How vocal sounds are produced

First and foremost, I define what a sound is and how it is produced. In simple terms, sound is a physical phenomenon made by vibrations. When an object vibrates, such vibration causes a motion in the particles of matter surrounding the object itself.

> A sound is said to exist if a disturbance propagated through an elastic material causes an alteration in pressure or a displacement of the particles of the material which can be detected by a person or by an instrument. (Beranek & Mellow 2012)

The frequency (the number within a fixed timespan) of the particles' displacement and return to the original position determines the pitch of the sound. Such frequency is measured in Hertz (Hz). For example, if we consider a pitch of 440 Hz propagated in air (the elastic material mentioned by Beranek & Mellow), the particles complete 440 cycles per second, and in each cycle the particles of air move and return to their original position. Higher frequencies (i.e. a high number of cycles of

vibration) produce higher pitches, whereas lower frequencies originate lower pitches. In general, it is easier for bigger objects to vibrate slower than faster, and it is easier for small objects to vibrate faster than slower. That is why – in the same family of musical instruments – smaller instruments generally produce higher pitches than bigger instruments, e.g. a violin and a double-bass, which have roughly similar shapes but different sizes.

In order to produce sound, the human voice needs three main components: a) an origin that causes the vibration, b) an oscillating object that vibrates and produces the abovementioned disturbance and displacement of air particles, and c) a resonator which vibrates in sympathy with certain partials (harmonics) of the original disturbance, thus amplifying them and making the sound audible. In addition to these, we shall also consider d) a transmitter of the sound waves (normally the air around us, although exceptions are possible e.g. singing underwater), and e) a receiver (the hearing organs of other individuals). Titze (2008) roughly assigns a concrete object to each of these roles:

a) Origin of vibration (*power*) → respiratory system and breathing mechanism, mostly the lungs and the trachea (wind-pipe)
b) Oscillating object (*source*) → vocal folds located in the larynx
c) Resonator (*filter*) → mostly the structures of the body above the vocal folds, e.g. the throat, the pharynx, the mouth, the cavities in the head, etc., whose alteration in shape and size changes the properties of the sound.
d) [Transmitter] → usually the air around the source (note that without a transmitter sound cannot be heard, as it happens e.g. in open space)
e) [Receiver] → the hearing organs and brain of other human beings as well as the person who produces the sound as well

In this thesis, I focus on b) *source* and c) *filter*. The other three elements – and especially a) *power* – are left out despite being equally fundamental in producing and perceiving vocal sounds. The inclusion of the respiratory system would have required a considerably greater amount of space and a diffusion in the explanation, thus going beyond the manageable limits of this thesis. Therefore, I address it only very briefly. Secondly, transmitter and receiver mostly if not solely belong to the aesthesic aspect of the voice, that is how it is perceived by others (or by the singers themselves), therefore they do not belong in the primary scope of this thesis. I believe that source and filter are sufficient to accomplish the purpose of this work.

Figure 3.1 - The three main components of the phonating apparatus

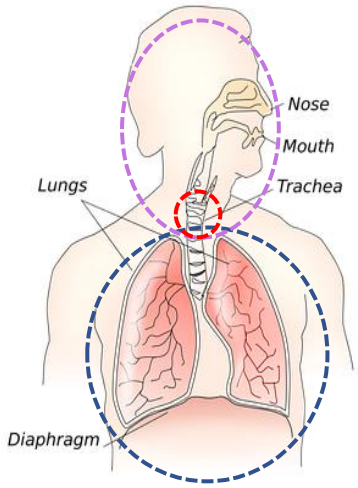


Figure 3.1: (Adapted from VoiceScienceWorks 2019).

It is commonly acknowledged in vocal science that "phonation must be coordinated to respiration" (Merati & Bielamowicz 2007: 43). In Figure 3.1, it is possible to identify, although roughly, the three zones of the body which correspond to power (the respiratory system, circled in blue), source (the larynx, where the vocal folds are locate, in red) and filter (the vocal tract and the resonating cavities, in purple). The starting point of phonation is technically located in the brain. The nervous system controls the complex sequence of actions required from our body to produce vocal sounds. In the torso, the lungs and the highly elaborate system of muscles, ligaments and other tissues connected to the respiratory mechanics originate the airflow required to set the vocal folds into vibration. Although I chose to leave the topic of breathing out of this thesis, the reader should keep in mind that this aspect of phonation is as important as the ones which are here dealt with.

Figure 3.2 - Vocal sound production

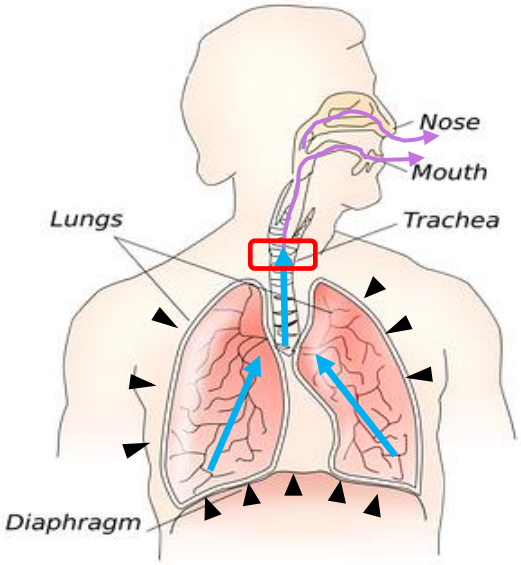


Figure 3.2: (Adapted from VoiceScienceWorks 2019)

Figure 3.2 schematizes the production of sound by the exhalating airflow, which passes through the vocal folds and sets them in motion. With the aid of the auxiliary muscles of the respiratory apparatus (black wedges), the airflow (blue arrows) is exhaled out of the lungs and into the bronchi and the trachea. In the larynx, the airflow meets the vocal folds and puts them into vibration, creating a sound (purple scribble) which, mixed with said airflow, resonates in all the cavities above the vocal folds and is furtherly modified by other structures such as mucosa, cartilages, bones, etc. “The mean rate of vocal fold vibration per second represents the habitual pitch also known as fundamental frequency” (Merati & Bielamowicz 2007: 31). The amount of airflow that continues its propagation depends on the configuration that the vocal folds and the structures above assume for a specific type of phonation. Certain phonations allow a considerable amount of air to pass through, whereas in others the airflow is mostly hindered and absorbed. In the next sub-chapter, I will explain how the source of the vocal sound, i.e. the vocal folds, interact with the airflow.

3.2 The vocal folds

The source of human phonation is located in the area of the throat named *larynx*, which is "a musculocartilaginous structure located in the middle of the anterior neck region" (Merati & Bielamowicz 2007: 32), and whose position is visible in Figures 3.2. and 3.3. Among other structures, the larynx contains two *vocal folds*[4]. Besides making the phonation possible, the closure of the vocal folds also plays other roles in human life: it protects the airway of the trachea and prevents foreign objects from going into it and possibly into the lungs, as well as closes the vocal folds when lifting heavy objects. On the contrary, open vocal folds leave way to the passage of air and therefore make breathing possible. Titze summarizes the main characteristics of the vocal folds as follows:

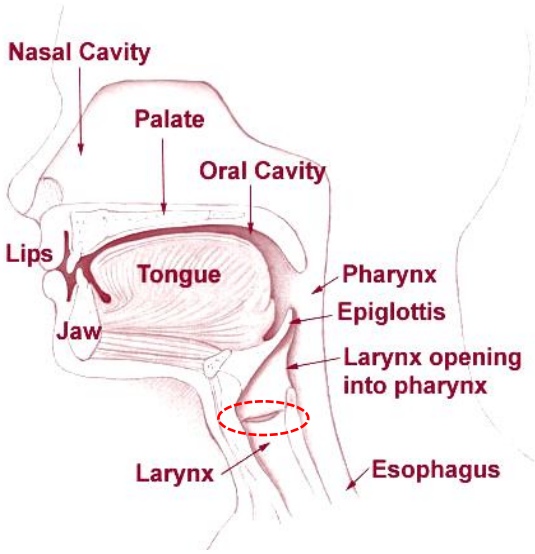


Figure 3.3: The location of the true vocal folds. Their position – circled in red – is about in the middle of the larynx. (Adapted from VoiceScienceWorks 2019)

Figure 3.3 - Location of the vocal folds

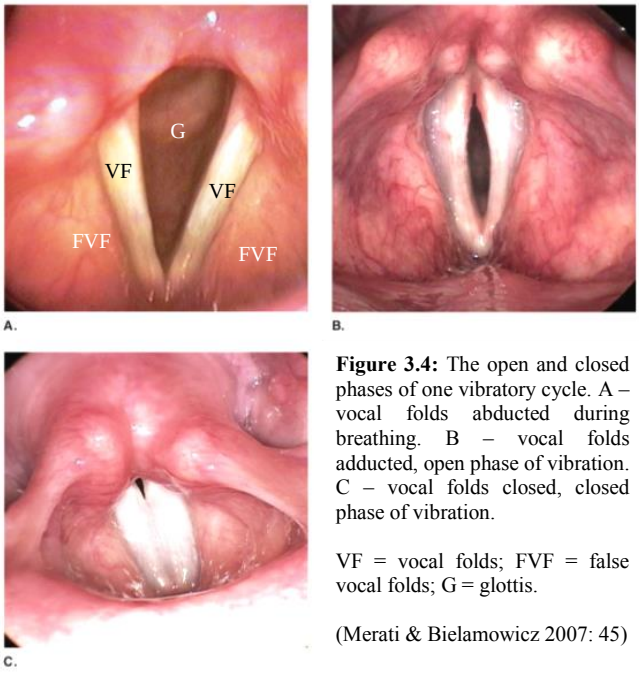


Figure 3.4: The open and closed phases of one vibratory cycle. A – vocal folds abducted during breathing. B – vocal folds adducted, open phase of vibration. C – vocal folds closed, closed phase of vibration.

VF = vocal folds; FVF = false vocal folds; G = glottis.

(Merati & Bielamowicz 2007: 45)

Figure 3.4 - Photo sequence of one vibratory cycle

> Vocal folds are two small bundles of specialized tissue […] that protrude pouchlike from the walls of the larynx. They generate a fundamental frequency by rapidly oscillating as they contact each other, separate and come in contact again. The glottis (the space between the folds) opens and closes. The laryngeal vestibule, an airway passage just above the larynx, acts like the mouthpiece of the trumpet to couple the sound to the remaining part

[4] Also known as 'vocal cords', or 'true vocal folds' to distinguish them from the structures immediately above them, which are called *false vocal folds* or 'vestibular folds' or 'ventricular folds'.

> of the resonator known as the vocal tract. The lips radiate the sound outward like the bell of the trumpet. (Titze 2008.)

The term ‘glottis’ identifies the opening between the vocal folds. The passage of the airflow through the glottis makes the vocal folds vibrate and therefore produce sounds. A gap between the vocal folds, even though a very narrow one, is needed for the air to flow through and set the folds in motion. If the folds are completely pressed against each other with no passage of air, there is no sound. Figures 3.3 and 3.4 show, respectively, the location of the vocal folds in the broad geography of the head and neck, and their vibratory cycle. The areas of the larynx below and above the glottis are respectively called ‘subglottis’ and ‘supraglottis’. These two terms are especially important when referring to e.g. the air pressure below (subglottal pressure) or above (supraglottal pressure) the vocal folds, or to other sub-/supraglottal structures of the larynx.

The vocal folds follow the same basic principle of other string instruments: shorter strings produce higher sounds while longer strings produce lower sounds, and at the same time looser strings produce lower sounds while tenser strings produce higher sounds. Nevertheless, the size of the vocal folds is extremely small – “the size of your thumbnail” (Titze 2008) – and even when maximally stretched their elongation possibility is minimal compared to the pitch range that many singers’ voices cover (some reach three, four or even five octaves). Titze (2008) explains how, although very small in size, the vocal folds are so finely engineered by nature that their layered and compound structure confers elasticity in length but also the ability – when used properly – to change the tension of the tissue itself, therefore their inner density, therefore the pitch of the sound created by their vibration. This being said, we can keep in mind three basic principles:

1) The number of complete vibratory cycles of the vocal folds in a given timespan (Hz = cycles per second) determines the fundamental frequency of a vocal sound.
2) This fundamental frequency determines the pitch of the sound.
3) The number of vibratory cycles of the vocal folds is primarily determined by a) their length, b) their tension, and c) the subglottal air pressure.

> Nature has addressed these problems by constructing the vocal folds out of a three-part material that displays properties not found in standard instrument strings. One component is a ligament that looks somewhat stringlike, which is why the folds came to be called "cords" popularly. Scientists have shown in biomechanical tests that the stress in this ligament rises nonlinearly when it is stretched just a little; it can be virtually limp when short but impressively tense when elongated. […] Biology has also found a second way to expand the pitch range of

> the vocal folds, including a material that can increase in tension as it shortens, namely, muscle tissue. The internal contraction of muscle fibers can raise the stress between a vocal fold's end points, even when the fold itself shortens. (Titze 2008.)

3.3 Laryngeal structures affecting the vocal folds: muscles and cartilages

The length and tension of the vocal folds is regulated by a complex system of muscles and ligaments attached to cartilages in the larynx. I here briefly present the most important structures participating in the laryngeal motion.

In the larynx, the largest cartilages are the thyroid cartilage, the cricoid cartilage and the epiglottis. Three smaller paired structures are the arytenoid cartilages, the corniculate cartilages and the cuneiform cartilages. The purpose of the laryngeal cartilages is mainly to support and protect the soft laryngeal tissues, including the vocal folds. These structures articulate with each other in complex ways through rotating and sliding movements in order to allow different tasks (e.g. breathing, eating, phonating), and return to their original position once the muscular tensions that maneuver their articulation cease. (Merati & Bielamowicz 2007: 32.) Most of these cartilages are also able to modify both the pitch and the quality of vocal sounds. The most elastic component of each vocal fold (Titze 2008), the vocal ligament, is attached to the thyroid cartilage in the front and to the arytenoid cartilages in the rear. Figure 3.5 presents a frontal, lateral and upper view of all these structures.

The muscles of the larynx can be divided into two main groups. The extrinsic muscles have one attachment to a structure outside the larynx, whereas the intrinsic ones have both attachments inside it. The collaboration of these two complex muscular groups regulates the motions of the abovementioned laryngeal cartilages, therefore also the elongation and tension of the vocal folds. (Merati & Bielamowicz 2007: 34.) The extrinsic laryngeal muscles (sternothyroid, thyrohyoid, inferior pharyngeal constrictor, supra- and infrahyoid) are primarily responsible for the support of the larynx as a whole, and they maintain it in position. The intrinsic laryngeal muscles (posterior cricoarytenoid, the lateral cricoarytenoid, the interarytenoid, the cricothyroid and the thyroarytenoid) actually move the vocal folds and intervene on their tension and elongation. Without going into further detail about their individual function, it is enough to say that their interaction is complex, and it constitutes a fine-tuned clockwork which maneuvers the laryngeal cartilages and the vocal folds with extreme precision, as shown in Figure 3.6.

The configuration of the vocal folds and their condition of length and tension affects the airflow originated in the lungs and exhalated through the trachea, thus originating the fundamental frequency of the vocal sound. As explained in §4.1, this affects a parameter of the singing voice commonly called *register*.

Figure 3.5 - Main laryngeal cartilages and ligaments

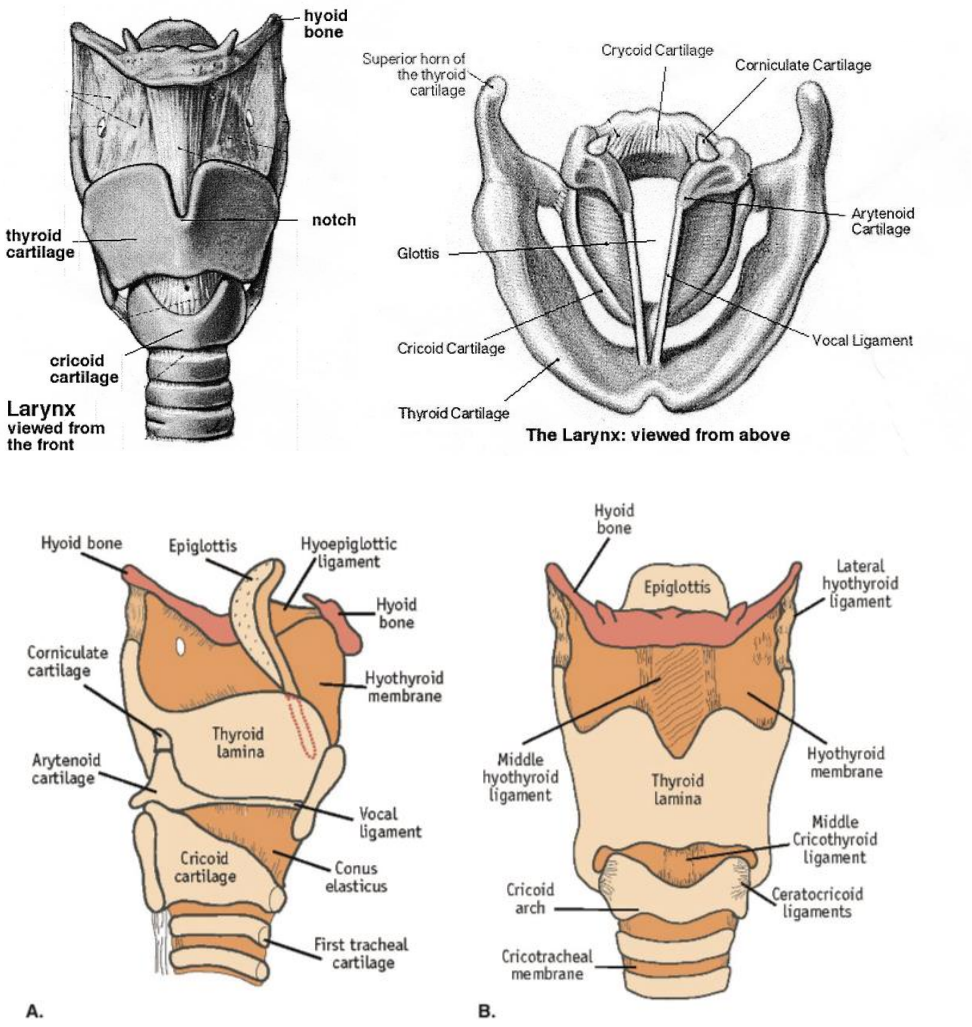


Figure 3.5: Main laryngeal cartilages and ligaments. In the upper picture (Wise 2007: 26), the epiglottis is not indicated, and the larynx is shown from the front (left) and above (right). The lower picture (Merati & Bielamowicz 2007: 33) also shows the epiglottis, with a lateral view (A) and a front view (B) of the larynx.

Figure 3.6 - Laryngeal motion

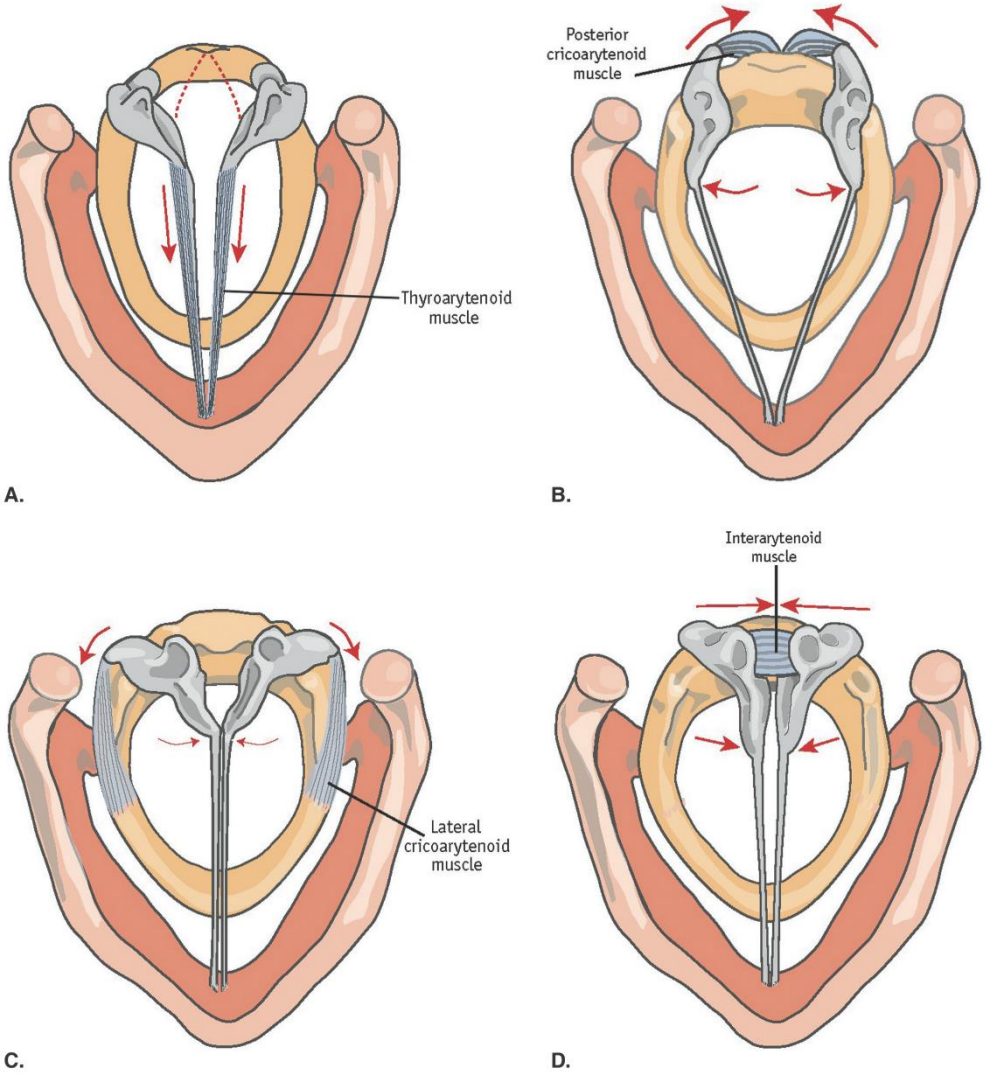


Figure 3.6: Four schematizations of how different laryngeal intrinsic muscles intervene on the vocal ligament. The contraction of the thyroarytenoids (A) shortens the vocal ligament and thickens the vocal folds, decreasing their tension; the posterior cricoarytenoids (B) abduct the vocal folds and widens the glottis; the lateral cricoarytenoids (C) stretch the vocal ligament and lengthen the vocal folds, increasing their tension; the adduction of the vocal folds and closure of the glottis is accomplished by a collaborative motion by the thyroarytenoids, the lateral cricoarytenoid (the most powerful of the adductors) and the interarytenoids (D). (Merati & Bielamowicz 2007: 39)

3.4 The vocal tract

The fundamental frequency needs a resonator where the vibration produced by the vocal folds is amplified and furtherly shaped into a more powerful sound with specific characteristics of its own. “The laryngeal vestibule, an airway passage just above the larynx, acts like the mouthpiece of the trumpet to couple the sound to the remaining part of the resonator known as the vocal tract. The lips radiate the sound outward like the bell of the trumpet.” (Titze 2008.) The vocal tract constitutes a

multi-layered and polyhedral resonator which also functions as filter, because it can take on various shapes and sizes in order to amplify the sound produced by the vocal folds and emphasize certain harmonic frequencies rather than others, thus modifying the timbre of the voice. As a general principle, the narrower the vocal tract or parts of it become, the brighter the sound, whereas a large and spacious vocal tract contributes to darkening the sound. Part of the structures of the vocal tract have already been mentioned in this chapter. The primary ones are showed in Figure 3.7:

Figure 3.7 - Elements of the vocal tract

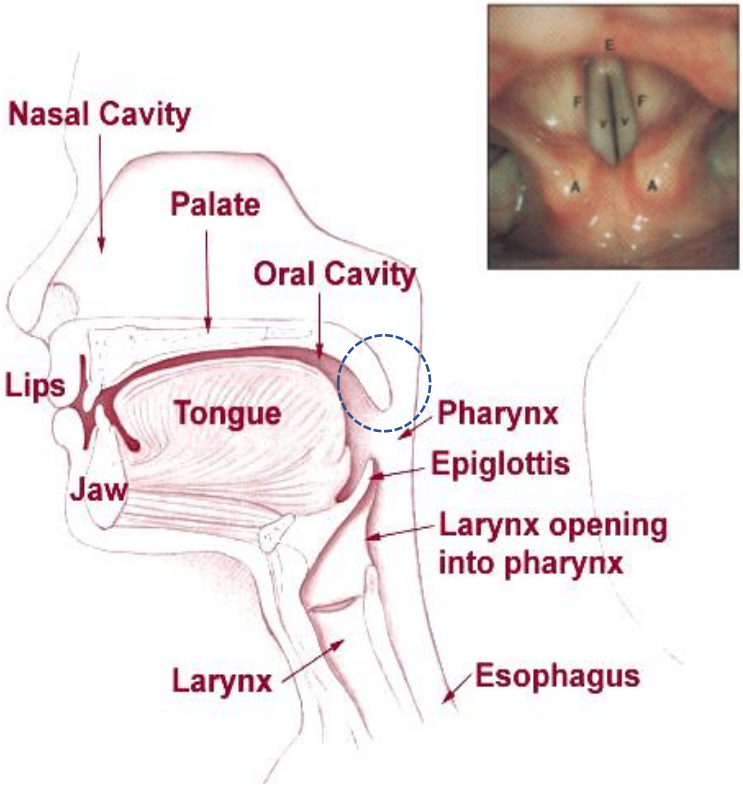


Figure 3.7: In the smaller picture (Sataloff 2013: 4) are indicated the true vocal folds (v), the false vocal folds (F), the arytenoids (A) and the epiglottis (E). In the larger picture (VoiceScienceWorks 2019), the blue dotted circle indicates the palatal velum.

- the false vocal folds, also called ventricular/vestibular folds
- the epiglottis and the complex of the arytenoid cartilages, including corniculate and cuneiform
- the larynx itself as a whole, which can be raised or lowered as explained in §4.3.1
- the pharynx
- the soft palate or palatal velum (circled in blue in Figure 3.7) which can prevent the airflow from resonating in the nasal cavities or, on the contrary, therein allow its passage
- the oral cavity including the tongue, hard palate, lips and jaw
- the nasal cavities

In the next chapter, I categorize the most important vocal elements and techniques into a classification of vocal sounds according to how they are produced.

4 A terminology compendium for heavy metal vocals

In this chapter, I present a compendium of vocal elements common in heavy metal. The elements of vocal physiology provided in the previous chapter are the basis to understand the more complex mechanisms presented here. For each key concept of the compendium, I provide a list of examples which – hopefully – help the reader to recognize such key concept through aural analysis. When dealing with these characteristics of the singing voice, it must be remembered that "they seldom appear in their 'pure' configuration: most of the time, they are combined together, therefore producing particular, sometimes very personal and recognizable vocal sounds." (Mesiä and Ribaldini 2015).

The examples follow these criteria: 1) variety of singers 2) variety of voice type or timbre (aurally assessed) 3) chronological variety 4) variety of heavy metal sub-genres (when possible). Sometimes, I refer to examples not belonging in the heavy metal genre, in case these are particularly suitable examples of the key concept they refer to. Unless otherwise specified, all examples refer to studio versions of the songs. My analysis focuses especially on the larynx and the vocal tract. Although many other physiological mechanisms are involved in the production of voice sounds, they are here mostly unaddressed.

These vocal elements are discussed in three categories: a) the vocal fold level that primarily affects the vocal register, b) the vocal tract level, where resonating sounds and effects are usually produced, and c) other vocal phenomena, usually combinations of the first two categories. This categorization and most of the technical material presented in this chapter were presented in a more limited dimension in the article "Heavy Metal Vocals. A terminology compendium" (Mesiä & Ribaldini 2015).

4.1 Vocal registers

Defining *vocal registers* has been a long and controversial process, which is partly still ongoing. The first definition of registers is probably ascribable to Manuel Garcia (1805-1906), a Spanish singer and vocal pedagogue who also invented the laryngoscope:

> By the word register we mean a series of consecutive and homogeneous tones going from low to high, produced by the same mechanical principle, and whose nature differs essentially from another series of tones equally consecutive and homogeneous produced by another mechanical principle. All the tones belonging to the same register are consequently of the same nature, whatever otherwise may be the modifications of timbre or of the force to which one subjects them. (Garcia 1847, translation by Paschke 1984. Quoted in Roubeau, Henrich & Castellengo 2009: 433.)

The homogeneity Garcia speaks about focuses on the glottal source. Roubeau et al. (2009) state that Garcia's definition was repeatedly misinterpreted throughout the conceptual history of registers. Due to said supposed misinterpretations:

> [In literature] the number of registers is variable depending on the authors, ranging from two (most frequently) to four. Their designation is often specific to the author. Thus we can find a group of terms referring to different notions, the choice of which reflects sometimes the type of approach (singing teaching, physiology and vocal therapy, mechanical, and acoustic). […] This proliferation of terms shows the great confusion, often evident in the literature, when it comes to the designation and identification of registers. This confusion first comes from the angle from which the author tackles the notion of register. Some authors define registers from a perceptual point of view, by the homogeneity of the timbre of the sound produced […]. Others define them from laryngeal configurations, whereas another category of authors combines the vibratory and resonance aspects. Frequently, these concepts are mixed up. (Roubeau, Henrich & Castellengo 2009: 434.)

Titze, for example, established the concept of registers as "perceptually distinct regions of vocal quality that can be maintained over some ranges of pitch and loudness" (2000: 282), with a clear emphasis on the perceptual approach. Furthermore, in the last two decades, numerous attempts to summarize the history of the multiple legit interpretations of registers and to shine further light on this topic have been made among others by Švec et al. (2008), Sundberg & Högset (2001), Blomgren et al. (1998), Titze (2014), Tokuda et al. (2010).

Examples of alternative terms to 'register' are 'vocal mode' and 'dominance area', with the latter related to the amount of thyroarytenoid muscle vs. cricoid muscles involved in the phonation (see Hirano et al. 1970; Kochis-Jennings et al. 2012; Titze 1988). The term 'Vocal mechanism', centered around the notion of laryngeal vibratory mechanism, recurs in recent research, and it developed under the necessity of giving order to the multitude of register names traditionally used in Euroclassical singing practices, and mostly determined through perception rather than sound production type:

> It seems that the concept of laryngeal mechanism may be used for a better understanding of the laryngeal level of production of a register, as it proposes a homogeneous mode of observation, applicable to all subjects and all styles of vocal expression. It is physiologically defined, and it is common to all subjects, male and female, singers and nonsingers, in singing and in speech. […] This approach has allowed us to demonstrate, in accordance with some of the literature, the existence of four distinct laryngeal vibratory mechanisms, identified by the analysis of transitions. These four laryngeal mechanisms, graded from low to high, from zero to three, ensure the production of the whole vocal range, for men's and women's voices, be they singers or nonsingers. […] The ranges produced by the different mechanisms are not contiguous but overlap each other, particularly in the case of mechanisms M1 and M2. Based on this physiological notion of laryngeal vibratory mechanism applicable to the whole of the human population, it is easy to understand that the parameters such as the production type (spoken or sung), the gender, and cultural context will guide the exclusive or privileged use of one mechanism rather than another. (Roubeau, Henrich & Castellengo 2009: 447.)

In commercially available singing methods, there are discrepancies about the denomination of registers, their definition, their functioning, and even their very existence. Estill Voice Training explicitly distances itself from the term 'registers', although it admits that expressions such as 'chest voice', 'head voice', and so on are used as a basis of common understanding to indicate different pitch areas of the voice (McDonald Klimek et al. 2009a: 21). On a practical level, despite its rebuttal of the term itself, EVT's understanding of registers substantially matches the conception according to which registers depend on the configuration of the glottal source. Perhaps, refusing to use the word is an attempt to avoid the intricated terminological discussion revolving around registers.

Complete Vocal Technique, on the contrary, uses the term briefly but coherently within its discourse (Sadolin 2012: 66-68). Nevertheless, it seems to dismiss the question of registers as a mere terminological controversy developed through the history of singing pedagogy. CVT's conception of registers is only tied to pitch, and it identifies five registers whose span goes from a certain pitch to another. Registers in males and females follow two different pitch divisions, but within the same sex, such divisions seem rather stiff and 'ultimate', without any consideration for different vocal identities and characteristics among singers of the same sex. Furthermore, CVT does not mention the glottal source configuration as a factor in identifying registers.

Nowadays, in vocal science is generally agreed that registers are associated with a) pitch, and b) the glottal voice source configuration – i.e. the position, length and tension of the vocal folds – such that *each register is produced with a specific set of vocal fold vibration characteristics*. While singing in the same register, the voice is produced similarly by the vocal folds, and it sounds alike unless further modified by the intervention of upper structures in the vocal tract. Logopedics, phonetics, phoniatrics

and vocology, which do not necessarily approach only singing but also vocal habilitation, speech, and the general functioning of the human voice, mostly identify four different registers, which may be aurally distinguished from each other. (Mesiä & Ribaldini 2015: 387.) These – represented in Figure 4.1 according to the perspective I adopt in this thesis – conventionally divide as follows:

1) *vocal fry* (or 'pulse register'), the lowest register
2) *modal*, divided into low modal and high modal according to pitch
3) *falsetto*[5], which partially overlaps to modal in pitch range
4) *whistle* (or 'flageolet'), the highest register

Figure 4.1 - Registers

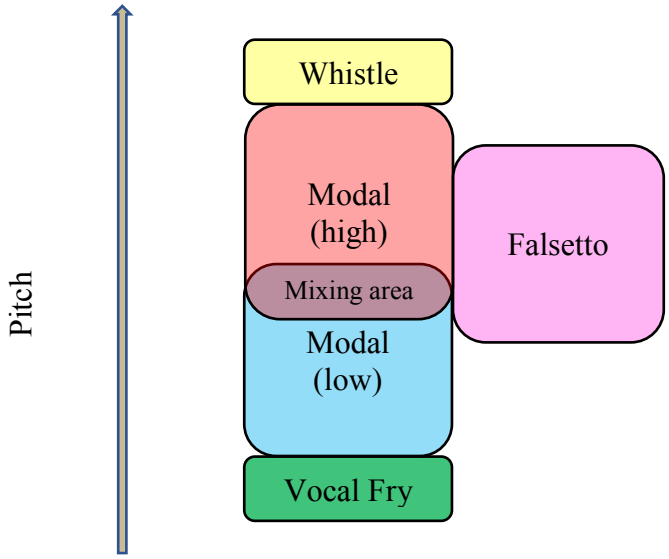


Figure 4.1: The diagram represents the categorization of the registers proposed in this compendium. Note that the low part of modal is often referred to as 'chest' and the high part of modal as 'head'.

Moving from any register to another with a sudden and clearly audible change in the sound quality is referred to as *vocal break*. Emphasizing vocal breaks, especially between modal and falsetto or head register, is common in yodeling and many contemporary popular music genres. If the singer wishes to make this break unheard, the two registers must be *mixed* (see §4.1.2).

[5] According to different sources, head register can be grouped under the same category as falsetto. Though ascribable to the same laryngeal vibratory mechanism, head voice and falsetto present different glottal source configurations (thin vocal folds closure VS. open vocal folds). This is why, in this thesis, I prefer grouping head voice with chest/speech voice under the category of modal.

4.1.1 Vocal Fry

Vocal fry has been studied at least since the 1960s, and the amount of literature on this topic is vast. In this register, vocal folds vibrate tightly but aperiodically against each other, and only a small part in the front of the glottis opens while the vocal folds vibrate (Laukkanen & Leino 2001: 49). The aperiodicity of the vocal folds' vibration produces a sound with a recognizable tone, but also a considerable amount of white noise. Figure 4.2 shows the difference between the regular vibration of the vocal folds in modal and falsetto registers, and the more irregular vibration of the folds in vocal fry.

Vocal fry is generally associated with the lowest pitch range of the human voice: "Average frequencies of vocal fry vibration, extrapolated from the literature, range from approximately 20 to 70 Hz with a mean of approximately 50 Hz" (Blomgren et al. 1998: 2649). When approaching registers through the key concept of laryngeal vibratory mechanism, vocal fry roughly corresponds to M0.

Figure 4.2 - Videokymography in three registers

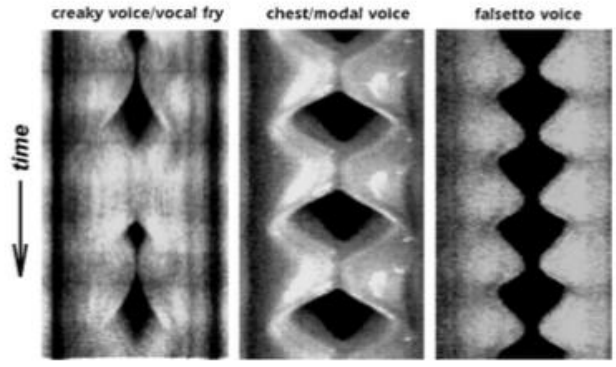


Figure 4.2: Videokymography of the vocal folds in three different registers: vocal fry (left), chest / lower modal (center), falsetto (right). (Švec 2002: 7)

"Vocal fry may sometimes be heard in normal speech, especially in the end of a phrase or when a person is speaking lazily or without any support from the body. This produces a 'popping' sound, in which each vibration of the vocal folds may be heard separately." (Mesiä & Ribaldini 2015: 387.) In singing, vocal fry can be used at the beginning as well as in the end of musical phrases, usually as onset or offset into or out of modal register. Nix (2016: 12) suggests that "fry onsets are used by

popular and country singers as part of a genre specific display of effort, in order to convey deep and sincere emotional involvement with the sung subject matter."

> […] the laryngeal mechanism M0, which allows the production of the lowest sounds of human phonation, is characterized by very short vocal folds, very thick and lax. The contact phase is very long in relation to the duration of a glottal cycle. […] the shape of a glottal cycle is not necessarily reproducible from one period to the next period. Thus, one can observe a periodic glottal cycle, with a very low frequency, or nonperiodic-impulsions, or multiple cycles (doubles and triples). (Roubeau, Henrich & Castellengo 2009: 431.)

> It was observed that the subjects in the present study tended to produce the ‘‘best’’ vocal fry phonation when their fry production was perceived to be relaxed with no perception of tension. The present findings of decreased subglottal pressure indirectly supports [sic] the notion that reduced vocal fold tension may be required to produce vocal fry. (Blomgren, Chen, Ng & Gilbert 1998: 2656.)

> Vocal fry has become more prevalent in popular and country singing at the onset of sung phrases. […] Due to its low fundamental frequency and intensity, vocal fry onsets are difficult to hear over accompanying instruments, especially in larger venues and without amplification. […] Amplification systems enable this use of fry as an emotive display by boosting the level of the fry phonation in what would otherwise be an acoustically challenging environment. (Nix 2016: 12.)

In recent years, vocal fry has raised an increased interest due to the intensive use of this register in speech among young female population in the English-speaking countries (e.g. Wolk et al. 2012; Abdelli-Beruh et al. 2016). Some of these studies suggest that a prolonged and frequent use of vocal fry in speech phonation increases the risk of vocal pathologies due to overuse of the vocal fold tissue.

Table 4.1 - Examples of vocal fry

Singer	Artist	Song	Time	Lyrics	Additional notes
David Coverdale	Whitesnake	"Here I Go Again" (1982)	0:11	*I don't know where I'm going*	On the word "I"
David Coverdale	Deep Purple	"Soldier of Fortune" (1974)	0:35 →	*Come lay with me love me*	
Jared Leto	30 Seconds To Mars	"The Kill (Bury Me)" (2005)	0:09	*What if I wanted to fight*	On the word "What"
Robert Plant	Led Zeppelin	"Stairway to Heaven" (1971)	0:55	*There's a lady who's sure*	On the word "lady"
Jon Bon Jovi	Bon Jovi	"Bed of Roses" (1992)	3:05	*I wanna lay you down*	On the word "I"

Vincent Price[6]	Iron Maiden	"The Number of the Beast" (1982)	0:00 →	*Woe to you, o earth and sea*	
James Hetfield	Metallica	"Nothing Else Matters" (1991)	1:27	*Life is ours*	On the word "Life"
Floor Jansen	Nightwish	"Élan" (2015)	0:50	*Walk out*	On the word "out"

4.1.2 Modal

> […] a voice with rich (heavy) timbre, characterized acoustically by an abundance of second and higher harmonic energy. This register is generally produced by adult males in speech. It has been called modal voice, or modal register (Hollien, 1974), suggesting a statistical "mode" or norm, at least in adult males. Chest register is a related label that may have its origin in sensations in the trachea or chest when a harmonically rich timbre is produced (Titze, 1988a). Females also produce this timbre, but to a lesser degree […] The statistical mode, and hence modal register, may be slightly different for females than males. (Titze 2014: 2091.)

In the general field of vocal sciences, "modal identifies the register in which speech is usually produced" (Mesiä & Ribaldini 2015: 388). In singing research, though, the modal register itself is often divided into two, the lower modal or 'speech register' (also called 'chest register' or 'chest voice') and the higher modal or 'head register'. Both can be used with little or no air leakage as well as with a great air leakage, in order to control the amount of breathiness in the sound. The two parts of the modal register partially overlap. In the overlapping area, tones can be produced either in chest or head voice. Bridging smoothly between chest and head or vice-versa in this area is called *mixing* (see Figures 4.3, 4.4 and 4.5).

Figure 4.3 - Three schematic configurations of the vocal folds

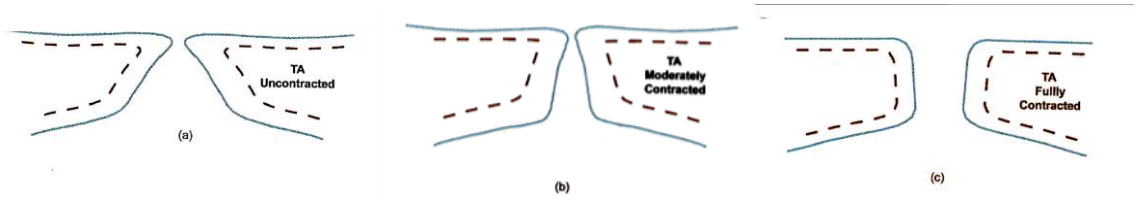


Figure 4.3: Three schematic configurations of the vocal folds (front view). In (a) the configuration for falsetto, in (b) for upper modal (head), in (c) for lower modal (chest). TA stands for thyroarytenoid muscle. (Titze & Verdolini-Abbott 2012: 271)

[6] Vincent Price (1911-1993) was an American actor best known for his work in horror films. In 1982, he provided the initial narration for Iron Maiden's track "The Number of the Beast", although he was never a member of the band.

Figure 4.4 - Video stills of tone phonation

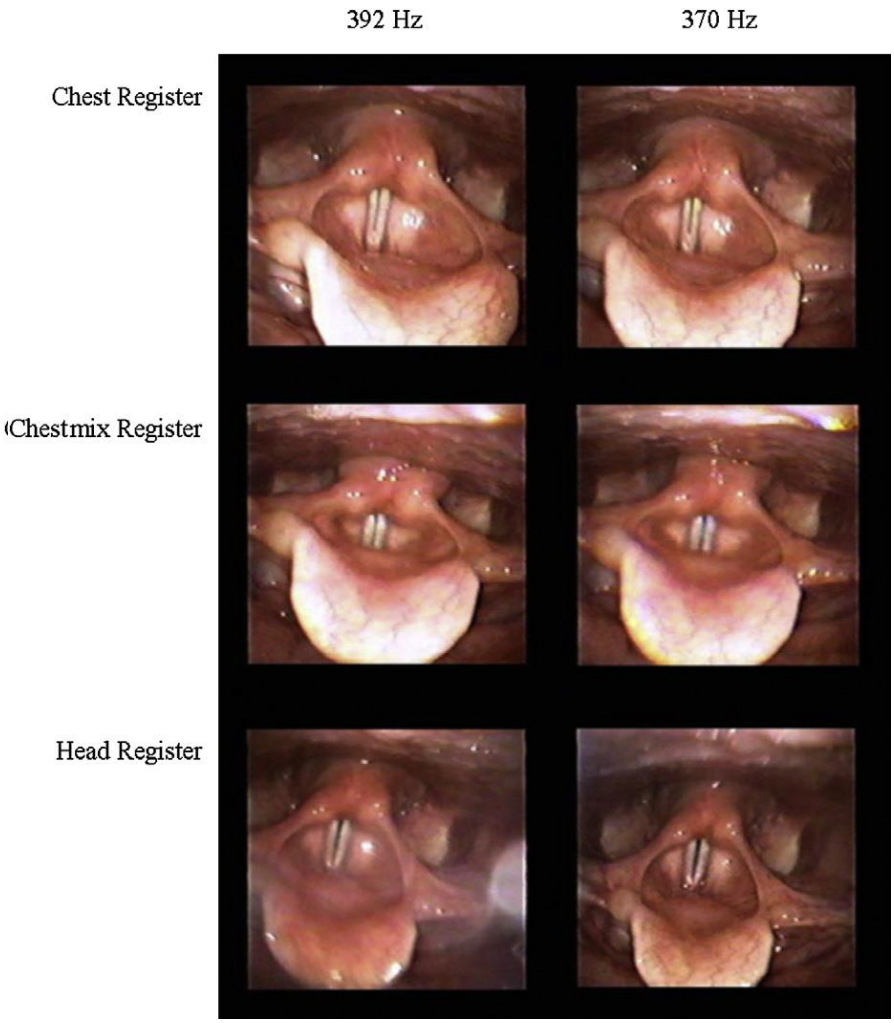


Figure 4.4: Video stills of tone phonation in a female subject. Phonation happens at 392 Hz and 370 Hz in low modal, in the overlapping area between low and high modal (with mixing) and in high modal. (Kochis-Jennings et al. 2012: 191)

Speech register presents a thick depth of contact throughout all or most of the vertical layers of the vocal folds, which "produce a full-bodied rich sound" (Mesiä & Ribaldini 2015: 388). This configuration is often called 'thick vocal folds'. Its alternative common name 'chest voice' derives from the fact that the frequencies of the low-pitch range more easily propagate on extended surfaces and in vast cavities of the body, including the singer's chest area. The same logic also applies to the upper part of the modal register and its common name 'head voice'.

Figure 4.5 - Vocal folds in modal register

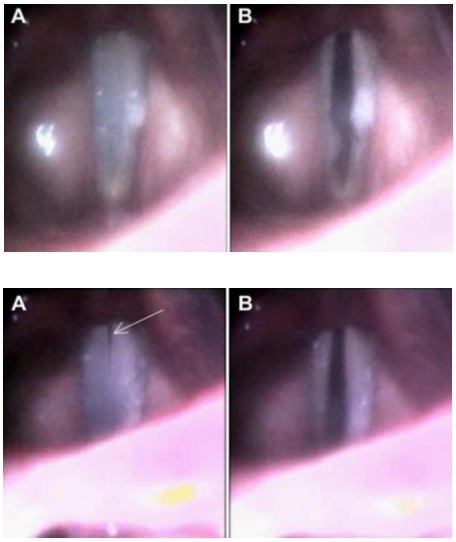


Figure 4.5: Stroboscopic view of a female singer's vocal folds in lower modal (up) and upper modal (down).

Frames (A) refer to the moment of maximal glottal closure, i.e. when the vocal folds are adducted. Frames (B) refer to the moment of maximal glottal opening, i.e. when the vocal folds are open.

In the upper frames, the white bulging objects on the vocal folds are accumulated mucus. In the lower (A) frame, the white arrow points at the narrow gap left in the posterior glottis after the transition to upper modal. The anterior glottis is partly hidden by the epiglottis.

(Švec et al. 2008: 349-350)

Table 4.2 - Examples of low modal (chest)

Singer	Artist	Song	Time	Lyrics	Additional notes
Joe Lynn Turner	Deep Purple	"King of Dreams" (1990)	0:33 →	*It doesn't matter if I'm right or wrong*	
Ronnie James Dio	Dio	"Holy Diver" (1983)	1:53 →	*Gotta get away*	
Bonnie Tyler	Bonnie Tyler	"Holdin' out for a Hero" (1984)	0:33 →	*Where have all the good men gone*	Female
Rob Halford	Judas Priest	"Turbo Lover" (1986)	0:25 →	*You won't hear me*	Air leakage, breathiness
Eric Adams	Manowar	"Heart of Steel" (1988)	0:33 →	*Build a fire, a thousand miles away*	
Doro Pesch	Warlock	"All We Are" (1987)	0:00 →	*All we are*	Female
Johan Längqvist	Candlemass	"Crystal Ball" (1986)	0:16	*Black heart, your soul is mine*	
David Coverdale	Whitesnake	"Fool for your Lovin'" (1980)	0:25	*I was born under a bad sign, left out in the cold*	
Tarja Turunen	Nightwish	"Nemo" (2004)	0:15 →	*This is me for forever*	Combined with Euroclassical singing style

Orson Welles[7]	Manowar	"Defender" (1987)	0:25 →	*When you are old enough to read these words*	Spoken

When singing in head register, the vocal folds close only from the upper part, producing less overtones and therefore a thinner sound (Mesiä & Ribaldini 2015: 388). This configuration is often called 'thin folds'. This has been demonstrated in many studies such as e.g. Sundberg & Thalen (2001), although in this specific article the authors use the term 'falsetto' to indicate head register, in accordance to the old terminology used in Euroclassical singing practices where falsetto is just the higher voice in male singers.

Table 4.3 - Examples of high modal (head)

Singer	Artist	Song	Time	Lyrics	Additional notes
Giacomo Voli	Rhapsody of Fire	"Wings of Destiny" (2017)	0:20 →	*Day has gone, but I'm still here*	With addition of air
Blackie Lawless	W.A.S.P.	"The Idol" (1992)	1:42 →	*Will I be alone this morning*	Small air leakage, mild breathiness
Jim Gillette	Nitro	"Freight Train" (1989)	0:05	-	
Ian Gillan	Black Sabbath	"Born Again" (1983)	2:10	-	
Ian Gillan	Deep Purple	"Child in Time" (1970)	2:37 →	-	
King Diamond	King Diamond	"Abigail" (1987)	2:17 →	*Oh Jonathan*	
Rob Halford	Judas Priest	"Savage" (1978)	0:02 →	-	
David DeFeis	Virgin Steele	"Immortal I Stand" (2006)	0:00 → 0:09	-	
Peter Steele	Type O Negative	"Love You to Death" (1996)	1:09 →	*Black lipstick stains her glass of red wine*	
Don Dokken	Dokken	"Breaking the Chains" (1983)	0:17 →	*Sit there thinkin' in your room*	

[7] Orson Welles (1915-1985) was an American actor, director, writer and producer who worked in radio, theater and film. Never a member of the band Manowar, Welles provided narration for the track "Defender".

Shifting from chest to head and vice-versa, or singing in the area where the two overlap, may trigger an aurally perceptible instability in the sound, with a brief pitch jump and a loss of consistency in the phonation (vocal break, also called 'registration' e.g. in Titze 2014). Sometimes, in order to prevent these audible changes, the two registers are mixed, making them sound as only one wide, smooth and coherent register (Mesiä & Ribaldini 2015: 388). Various studies have proved that the two main factors in commanding mixing technique are a) control of the subglottal pressure (Titze 2014) and b) balance in the intervention of the thyroarytenoid, the cricothyroid and the lateral cricoarytenoid muscles (Kochis-Jennings et al. 2012). Some singers are able to put mixing in practice without any specific training, some need to consciously practice in order to find balance within these two factors.

> A complete causal description of vocal registers must take into account that registration can be controlled voluntarily (as in an artistic yodel), that its effect can be softened voluntarily by register "mixing," and that involuntary shifts and instabilities in registration occur […]. (Titze 2014: 2092)

Table 4.4 - Examples of mixing

Singer	Artist	Song	Time	Lyrics	Additional notes
Steve Perry	Journey	"Faithfully" (1983)	3:17	-	
Ronnie James Dio	Rainbow	"Gates of Babylon" (1978)	0:58	*I can take you anywhere*	
Till Lindemann	Rammstein	"Ich Tu Dir Weh" (2009)	1:42 →	*Ich tuh dir Weh, tut mir nicht Leid*	
Bruce Dickinson	Iron Maiden	"Aces High" (1984)	0:55 →	*Jump in the cockpit and start up the engines*	
Timo Kotipelto	Stratovarius	"Hunting High and Low" (2000)	0:45 →	*Now I'm leaving my worries behind*	
Bobbie "Blitz" Ellsworth	Overkill	"Wish You Were Dead" (2012)	0:17	-	Combined with distortion
Fabio Lione	Rhapsody	"Dawn of Victory" (2000)	0:41 →	*Fire is raging on the battlefield*	
Glenn Hughes	Black Sabbath feat. Tony Iommi	"No Stranger to Love" (1986)	2:20 →	*Living on the street, I'm no stranger to love*	
Floor Jansen	Nightwish	"Élan" (2015)	1:18 →	*Come, taste the wine, raise the blind*	
Jimi Jamison	Survivor	"Is This Love" (1986)	0:51 →	*Is this love that I'm feeling*	

4.1.3 Falsetto

In the literature of vocal science, there are different definitions of falsetto. The one I refer to in this thesis is summarized in Figure 4.6. Thurman et al. (2004: 26, cited in Mesiä & Ribaldini 2015: 388) identify falsetto as a voice quality that adult males can produce within the female pitch range, and which is female-like in quality. Estill Voice Training (McDonald-Klimek et al. 2009b: 21) re-defines it as a 'voice quality', characterized by the vocal folds vibrating completely or partially separated and in a stiff state. Vilkman et al. (1995: 66) state that "in falsetto the vocal folds are thin, only the vocal-fold edges vibrate, and the glottal closure is incomplete". Similar concepts are also presented in Sundberg & Högset (2001) and Švec et al. (2008). Titze presents it as follows:

> One perceptual category is a voice with a light timbre, characterized acoustically by a predominance of first harmonic energy. It is often referred to as the falsetto voice, or falsetto register. In males, it is akin to the boy voice. In females, the child- adult distinction is less dichotic (with no separate labels) because pubertal voice changes are not as dramatic in females as in males. (Titze 2014: 2091.)

Figure 4.6 - Vocal folds in falsetto

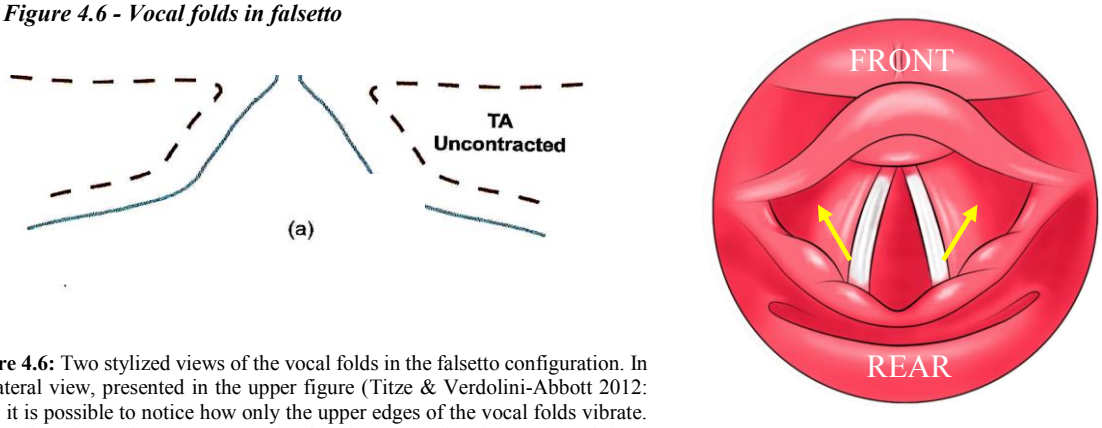


Figure 4.6: Two stylized views of the vocal folds in the falsetto configuration. In the lateral view, presented in the upper figure (Titze & Verdolini-Abbott 2012: 271), it is possible to notice how only the upper edges of the vocal folds vibrate. In the view from above, presented in the picture on the right (adapted from VoiceScienceWorks 2019) the yellow arrows indicate that the vocal folds are partially or fully separated.

According to Estill's and Titze's definition of falsetto, this register can be produced by both females and males, although literature widely acknowledges that the aural difference between speech and falsetto is greater in males than in females. In its lower range, falsetto sounds breathy, but as it rises higher the breathiness is reduced and may be difficult to separate falsetto from head register.

Table 4.5 - Examples of falsetto

Singer	Artist	Song	Time	Lyrics	Additional notes
Blackie Lawless	W.A.S.P.	"Hold on to my Heart" (1992)	0:55	*Ooh, can't put it out*	Combined with very light distortion
Blackie Lawless	W.A.S.P.	"Wild Child" (1985)	1:17	*You*	With backing vocals
Ian Gillan	Deep Purple	"Child in Time" (1970)	1:53	-	
Amy Lee	Evanescence	"My Immortal" (2003)	0:11 →	*I'm so tired of being here*	Female, low range
King Diamond	King Diamond	"Abigail" (1987)	0:36 →	*Miriam, can you hear me?*	Very high, difficult to distinguish from head voice
Fabio Lione	Rhapsody	"Wings of Destiny" (1998)	0:37	*My green hills*	On the word "hills"
Tony Kakko	Sonata Arctica	"Replica" (1999)	0:25	*I'm home again*	On the word "I", low range
Dolores O'Riordan	The Cranberries	"Zombie" (1994)	1:10 →	Falsetto used in the middle or at the end of certain words as an embellishment	
Glenn Hughes	Deep Purple	"Hold On" (1974)	0:50	*You got the power*	On the word "You"
Ville Valo	HIM	"Wicked Game" (1997)	0:50	*Now I wanna fall in love*	On the word "I"

4.1.4 Whistle

The whistle register is still quite unknown and the literature about it is not extensive yet. Whistle allows the production of the highest sounds in the human voice, but it is very rarely used in either speech phonation or singing, and only a minority of singers know how to access it. (Roubeau et al. 2009: 429.) It seems to be characterized by a narrow opening between the vocal folds – which are very thin and stretched, as shown in Figure 4.7 – to enable a whistling sound (Laukkanen & Leino 2001: 50; Roubeau et al. 2009: 429). Although it is commonly considered a prerogative of children and women, there are some examples of male whistle register in heavy metal.

Figure 4.7 - Vocal folds in whistle

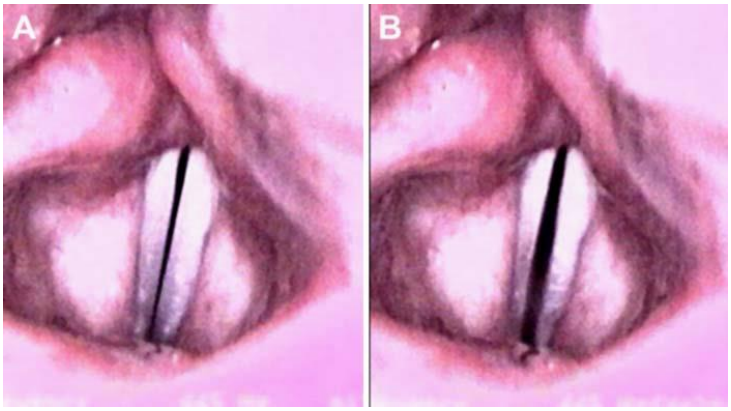


Figure 4.7: Stroboscopic views of a female singer's vocal folds phonating at 1590 Hz (G6). Frame (A) shows the vocal folds at the maximal glottal closure, frame (B) at the maximal glottal opening. (Švec et al. 2008: 351)

Table 4.6 - Examples of whistle

Singer	Artist	Song	Time	Lyrics	Additional notes
Chuck Shuldiner	Death	"Painkiller" (1998)	0:21	-	Might also be head register
Nicola Sedda	Nicola Sedda	"Colors" (2014)	2:47	-	
David DeFeis	Virgin Steele	"Immortal I Stand" (2006)	0:09	-	
Minnie Riperton	Minnie Riperton	"Lovin' You" (1974)	0:57	-	Outside heavy metal, female
Mariah Carey	Mariah Carey	"Vision of Love" (1990)	2:45	-	Outside heavy metal, female

4.2 Vocal effects

In popular music, there is no ideal sound for the human voice. Zangger Borch and Sundberg (2011: 532) suggest that voice usage may differ substantially between different singing styles. The aesthetic value of singing is often considered through the musical tradition of the genre, and as expression of the singer's personality. Singers therefore often make great changes in their voice production looking for a distinct personal sound to separate them from other singers. These differences are usually aurally detectable, even by a non-trained ear. (Mesiä & Ribaldini 2015: 389.)

Unlike registers, vocal effects involve changes in the supraglottal structures of the vocal tract instead of the true vocal fold configuration. This means that theoretically vocal effects are 'added' on top of any registers. In practical terms, for both physiological and aesthetic reasons, certain vocal effects are easier or more effective, therefore more common, when combined with certain specific registers.

4.2.1 Vibrato

According to Sundberg, vibrato presents differing acoustical and/or physiological characteristics in different music traditions and cultures. Vibrato is "a regular pulsating change in the tone, and/or an undulation of the fundamental frequency" (Mesiä & Ribaldini 2015: 389); according to the degree of a singer's technical control and musical awareness, vibrato can be intentional or unintentional. The kind of vibrato that changes the pitch is called 'laryngeal vibrato' (see Figure 4.8), in which two elements are considered: the vibrato rate, which specifies the number of undulations per second (how 'fast' the vibrato is), and the extent, which describes how far the vibrato pitch departs up and down from the original (how 'wide' it is). (Sundberg 1994: 45.) Sundberg also presents three hypotheses on why vibrato is generally used:

> In our Western music culture […] [m]ostly we hear several tones at the same time which form consonant intervals such as thirds, fifths, and octaves. In such cases a failing accuracy in tuning is revealed to us not only in terms of the pitch perceived but also in terms of beats. If such intervals are sung slightly out of pitch, beats occur. The greater the pitch error, the quicker the beats, and eventually they give rise to roughness.
>
> However, if the notes producing the consonant interval are sung with vibrato, no beats will occur. This means that the vibrato eliminates those beats which reveal that the consonant interval was not in accordance with the pure tuning. It should be noted, that pure tuning is not generally used in music practice, because it tends to sound queer in many contexts. Certainly this is a very good acoustical argument for using vibrato in singing as well as in other types of music. The singer's freedom is increased regarding the choice of fundamental frequency so that it can be used artistically, for expressive purposes. In other words, the vibrato gives the singer access to fine tuning as a means of musical expression.
>
> It is also possible that the vibrato makes the singer's voice easier to discern against the background of a loud orchestral accompaniment. The vibrato causes the partial to vary in amplitude, and it seems quite likely that a signal with strong high partials which vary in amplitude is more readily detected than a signal with a constant spectrum. […]
>
> A third possible *raison d'etre* for the vibrato is […] that vibrato-free tones consumed less air flow than vibrato tones. This suggests that vibrato tones are produced with lesser degree of glottal adduction than nonvibrato tones (Gauffin & Sundberg, 1989). We may then speculate that in a vibrato singing, phonation is somewhat farther away from overadducted, or pressed phonation than in nonvibrato singing. Perhaps the singer uses the vibrato

to signal to the audience that phonation is far from pressed. In other words, the vibrato might be used in order to inform the listeners that the singer is solving a difficult vocal task without a struggle. It is certainly a basic condition for creating an aesthetically and artistically satisfactory result that difficult tasks are solved without apparent difficulty. (Sundberg 1994: 64-65.)

Figure 4.8 - Laryngeal vibrato

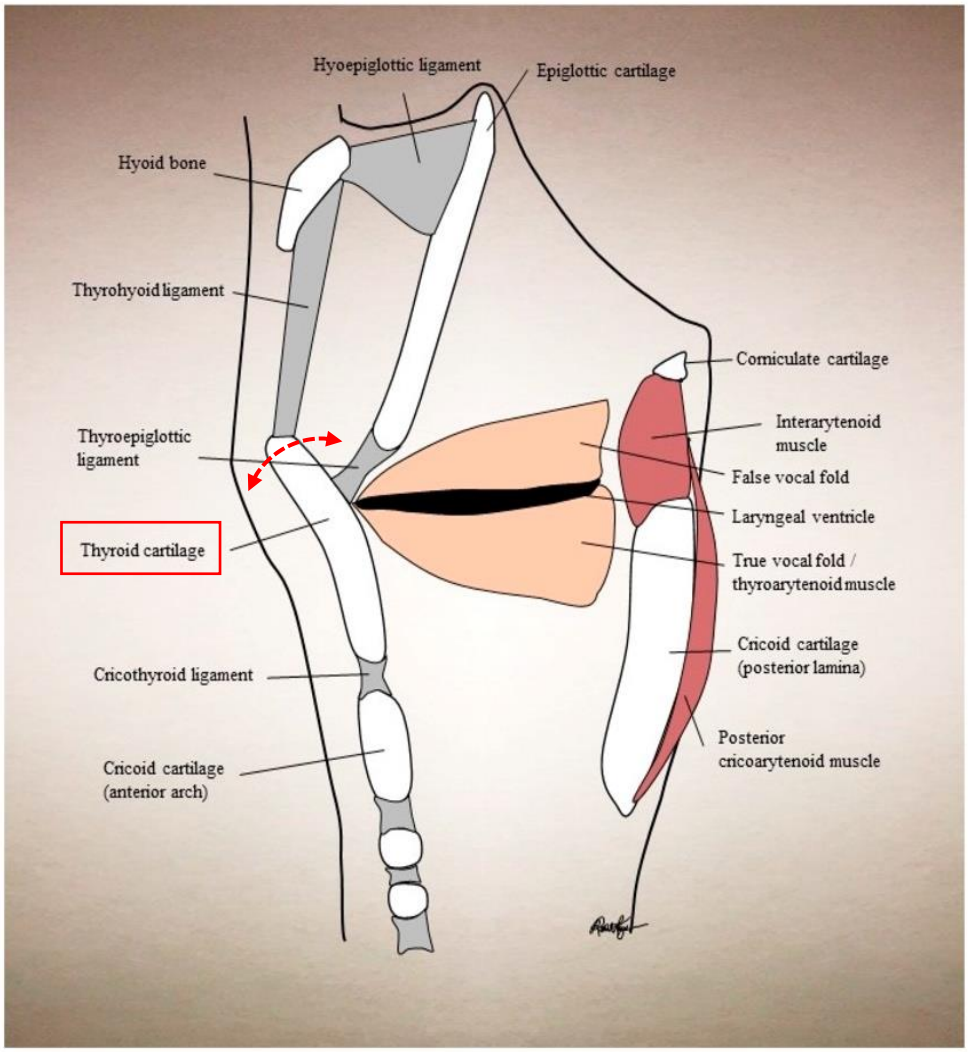


Figure 4.8: A schematic view of the larynx (adapted from Kay & Blitzer 2017), which shows the main mechanism involved in producing the so-called 'laryngeal vibrato': the red dashed arrow points out the alternate forward and backward tilt of the thyroid cartilage, which elongates and shortens the vocal folds, thereby producing a minor but perceptible change in the pitch. Usually, the wider the tilt the larger the extent of the vibrato.

Another way to produce vibrato, which Sundberg does not discuss, is the so-called 'hammer vibrato' (also commonly known as 'goat vibrato'). It is assumed that this type of vibrato is produced at the vocal folds level by quickly changing their closure. Hammer vibrato does not influence pitch, but

rather it may be identified as a pulsation (Sadolin 2012: 209). Such vibrato is less common in popular music, and it was used, for example, by the French singer Edith Piaf.

Table 4.7 - Examples of vibrato

Singer	Artist	Song	Time	Lyrics	Additional notes
Bruce Dickinson	Iron Maiden	"Run to the Hills" (1982)	1:10	*Run to the hills*	On the word "hills"
Ian Gillan	Deep Purple	"Highway Star" (1972)	2:08	-	Live version from the album "Made in Japan"
Fabio Lione	Rhapsody	"Holy Thunderforce" (2000)	0:10	*Holy thunderforce*	On the word "Holy"
Joey Tempest	Europe	"The Final Countdown" (1986)	1:25	*We're leaving together, but still it's farewell*	On the words "together" and "farewell"
Tarja Turunen	Nightwish	"Phantom of the Opera" (2002)	0:48	*The phantom of the Opera is there*	On the words "phantom" and "there"; combined with Euroclassical singing
Tobias Sammet	Edguy	"Tears of a Mandrake" (2001)	1:35	*The sea he'll cruise, his blood and fire*	On the word "fire"
Rob Halford	Judas Priest	"Painkiller" (1990)	1:55	*Brighter than a thousand suns*	On the word "suns"
Joe Lynn Turner	Rainbow	"I Surrender" (1981)	0:05	*I surrender*	
Mark Boals	Yngwie Malmsteen	"You Don't Remember, I'll Never Forget" (1986)	0:25	*It was you, it was me, and we would last forever*	On the words "me", "last" and the ending of "forever"
Geoff Tate	Queensrÿche	"I Don't Believe in Love" (1988)	0:24	*Searching high and low*	On the word "low"

4.2.2 Twang

Twang is a vocal effect or technique aimed to enhance the frequencies of the voice comprised between 2-4 KHz, therefore producing a more piercing and metallic sound. Since this pitch frequency fork is strongly perceived by human hearing, heavily twanged sounds result louder to the listener than sounds without or with little twang. Twang is frequently used in many singing styles of popular music, such as rock, pop, and folk, as well in ethnic singings of many cultures. Sundberg & Thalen (2010: 654) suggest that twang is also used in Euroclassical singing, to achieve a more projected sound (which is generally referred to as 'squillo' in the Euroclassical tradition, meaning "ringing" in Italian language).

Both Estill Voice Training (McDonald Klimek et al. 2009a: 87-89) and Complete Vocal Technique (Sadolin 2012: 51-52), although with minimal differences in their explanations, picture twang as usually obtained by narrowing the epilarynx – that is the upper part of the larynx, above the vocal folds – through a backward tilting of the epiglottis and a slight forward tilting of the arytenoid cartilages, as shown in Figure 4.9. As a result, the sound produced by the vibration of the vocal folds enters a narrow tube – called 'epiglottic funnel' in the picture – where the middle and high frequencies are amplified. The amount of twang may be adjusted by the singer, from small narrowing causing brightness to almost full closure which may cause distortion or growl (see §4.2.3 and §4.2.4). Sadolin also states that a minimum amount of 'necessary twang' is always inseparable from healthy singing. Indeed, while some singers use it sporadically, others do it constantly and make twang a key characteristic of their overall sound. Sundberg & Thalen investigated the twang technique and discovered two automatic effects produced when twanging: a slight increase of the subglottal pressure under the vocal folds and a greater vocal folds' adduction. This seems to indicate that twang might be used by some singers as a strategy towards a healthier phonation. (Sundberg & Thalen 2010).

Figure 4.9 - Twang

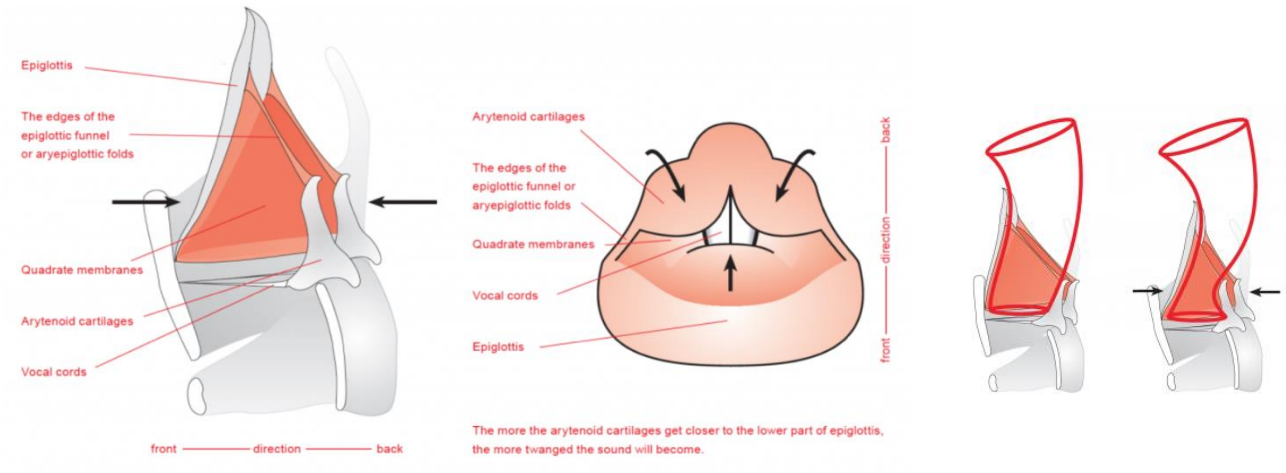


Figure 4.9: The mechanism that produces twang, according to Sadolin. The epiglottis tilts backwards while the arytenoid cartilages tilt forward. The first picture (left) shows a lateral view of the larynx. The second on (middle) is a view from above. The third (right) shows the action of twang on the airflow, and consequently on the sound. (CVT Research 2019)

Although it may aurally be confused with nasality, twang is not necessarily produced using nasal resonance. Estill's definition of nasalized twang refers to a nasal sound accomplished by opening the back of the soft palate (pharyngeal velum) during phonation, which allows the airflow to circulate in

the nasal cavities (McDonald-Klimek et al. 2009b: 42). Twang and nasality can however be combined. Such combination is found in American country music, especially sung by female singers, but is not really common in heavy metal, so examples are hard to find as such. (Mesiä & Ribaldini 2015: 390).

Table 4.8 - Examples of twang

Singer	Artist	Song	Time	Lyrics	Additional notes
Rob Halford	Judas Priest	"Angel" (2005)	0:28	*Angel*	Halford's sound has got generally speaking a high amount of twang
Rob Halford	Judas Priest	"Victim of Changes" (1976)	6:35	*Victim of changes*	
Axel Rose	Guns 'N' Roses	"Sweet Child o' Mine" (1987)	1:22	*Woah, sweet child of mine*	Combined with nasality
Ian Gillan	Deep Purple	"Knocking at your Backdoor" (1984)	1:35	*Smile on your face*	On the word "face"
Ozzy Osbourne	Black Sabbath	"War Pigs" (1970)	1:07 →	*Generals gathered in their masses*	Ozzy's sound has got generally speaking a high amount of twang
Kevin Heybourne	Angel Witch	"Angel Witch" (1980)	0:21 →	*Nobody else could see you*	
Udo Dirkschneider	Accept	"London Leatherboys" (1983)	1:15 →	*London Leatherboys, nightmare's pleasure, what you've done*	Udo's sound has got generally speaking a high amount of twang
Bon Scott	AC/DC	"Highway to Hell" (1979)	0:17 →	*Livin' easy, livin' free*	Scott's sound had got generally speaking a high amount of twang
Joey Belladonna	Anthrax	"Madhouse" (1985)	0:42	*I live alone inside my mind*	
Glenn Hughes	Deep Purple	"This Time Around" (1975)	1:06 →	*[...] I'd rather see the endless time and space go passing by*	

4.2.3 Distortion

Distorting effects of various nature are commonly used to confer more expressivity to the voice. In this thesis, the term 'distortion' encompasses a wide variety of effects which might sound quite different from each other. Some of them are commonly used in rock and classic heavy metal, whereas

others are more characteristic of extreme metal (e.g. what many extreme metal singers call 'scream'). Vocal science is producing an increasing amount of research on these kinds of phonation, but at the moment there seems not to be a consolidated enough base – especially from the poietic point of view – to classify these various distortion effects into a clear categorization. Therefore, the one here presented is not intended to be definitive. Of all the distorting effects, growl and grunt are the only ones that are dealt with separately in this thesis. I will hopefully be able to expand on this topic more in detail in future research.

Zangger Borch et al. (2004) name these sounds 'dist tones'. This variety of sounds is produced with different techniques, but generally speaking they are produced with a vibration of the supraglottic mucosa (the resonating parts of the vocal tract above the vocal folds), mostly of the false vocal folds, the epiglottis and the aryepiglottic fold. Such vibration can be aperiodic or periodic (irregular or regular): periodic vibrations are characteristic of ethnic voice production such as throat singing, whereas the distortion in rock is often aperiodic and adds white noise to the original tone.

Distortion has been considered very taxing to the voice for a long time in vocal science and vocal pedagogy. Voice rest is recommended after a prolonged use of such techniques, for example in a demanding heavy metal concert (Zangger Borch et al. 2004: 152-153). Nevertheless, no unmistakable scientific data about the topic exists yet. Whereas it is true that distortion techniques are generally harmful if not executed correctly, they vary greatly from singer to singer, and some singers can be particularly resistant. Furthermore, a high degree of proprioception and an advanced command of singing technique seem to reduce the amount of stress on the voice dramatically, thus minimizing the risk of damage to the vocal apparatus. Among others, Sadolin (2012: 179) argues that intentional distortion can be done safely without compromising vocal health. Caffier et al. (2018) state that:

> The common nonclassical vocal effects investigated do not lead to direct negative impairment in trained singers. In particular, if these effects are used only briefly, controlled, rather carefully, and as a specific means of expression, voice damage is not to be feared. The supraglottic phonation effects do not seem to affect the glottis. The vocal folds remain the most vulnerable part of the vocal apparatus. The possibility of long-term negative impact depends on the individual constitution, specific use, duration, and extent of the hyperfunction. (Caffier, Ahmed, del Mar, Wienhausen, Forbes, Seidner & Nawka 2018: 345.)

Table 4.9 - Examples of distortion (various types)

Singer	Artist	Song	Time	Lyrics	Additional notes
Ronnie James Dio	Dio	"Don't Talk to Strangers" (1983)	1:06	*Down*	
Jon Bon Jovi	Bon Jovi	"You Give Love a Bad Name" (1986)	0:35 →	*An angel's smile is what you sell*	
Anton Kabanen	Beast In Black	"Beast in Black" (2017)	0:07	*Berserker!*	
Noora Louhimo	Battle Beast	"Raven" (2013)	0:19 →	*Night sky is glowing*	Female
Bruce Dickinson	Iron Maiden	"The Number of the Beast" (1982)	0:27 →	*I left alone, my mind was blank*	
James Hetfield	Metallica	"Master of Puppets" (1986)	2:20 →	*Needlework the way*	
Rob Halford	Judas Priest	"Ram It Down!" (1988)	0:00	-	
Eric Adams	Manowar	"Kings of Metal" (1988)	0:37	*They wanna kick us down*	
not known	Gojira	"The Art of Dying" (2012)	0:00 →	-	Distortion with periodic vibration of the supraglottic mucosa
Blackie Lawless	W.A.S.P.	"Wild Child" (1985)	0:34 →	*I ride, I ride the winds that bring the rain*	
Shagrath (Stian Thoresen)	Dimmu Borgir	"Mourning Palace" (1997)	0:10	-	
Mortuus (Daniel Rostén)	Marduk	"The Blond Beast" (2015)	0:55 →	*Blackest shadow full of death*	
Spencer Sotelo	Periphery	"Marigold" (2016)	0:31 →		Shifts between distorted and clean
David Coverdale	Deep Purple	"Stormbringer" (1974)	0:22 →	*Coming out of nowhere, drumming like the rain*	
Phil Anselmo	Pantera	"Walk" (1992)	0:37 →	*Can't you see, I'm easily*	

4.2.4 Growl

Growl is a term sometimes used interchangeably to indicate grunt. Nevertheless, I agree with Sadolin in establishing a difference between growl and grunt. Growl is produced with normal phonation at the vocal folds level and with a turbulence effect created by a clear tilt of the epiglottis towards the arytenoid and cuneiform cartilages (see Figure 4.10), whereas in grunt the whole vocal tract is vibrating with low frequencies (Sadolin 2012: 192, 196).

Figure 4.10 - Growl

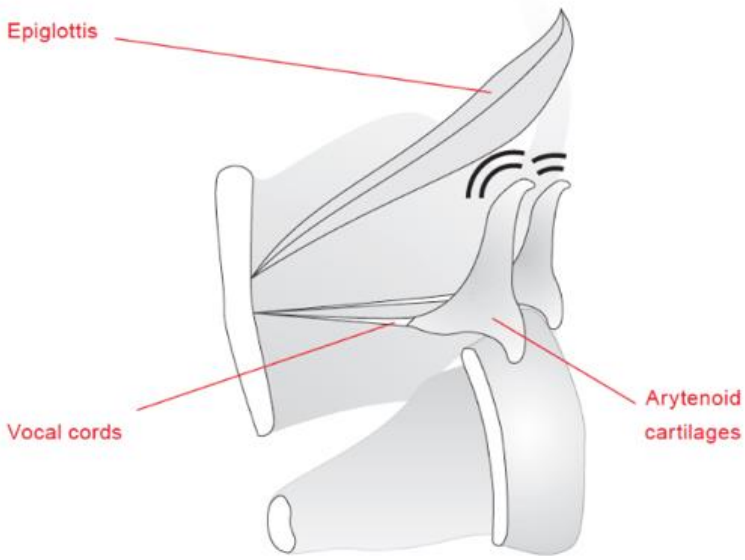


Figure 4.10: The mechanism that produces growl according to Sadolin (2012). The main turbulence derives from a vibration of the upper edges of the cuneiform cartilages. (CVT Research 2017)

In growl, the sound has a clearly audible fundamental pitch, whereas in grunt the fundamental pitch is not clearly recognizable. According to this definition, growl is an effect much heard in gospel, blues and soul music, less frequently in heavy metal.

Table 4.10 - Examples of growl

Singer	Artist	Song	Time	Lyrics	Additional notes
Till Lindemann	Rammstein	"Mein Land" (2011)	3:03	*Das ist mein Land*	On the words "mein Land"
Louis Armstrong	Louis Armstrong	"What a Wonderful World" (1967)	0:06	*I see trees are green*	On the words "trees" and "green"
Stevie Wonder	Stevie Wonder	"As" (1976)	3:45 →	*We all know, sometimes life's hates and troubles*	
Dolores O'Riordan	The Cranberries	"Zombie" (1994)	1:38	*Zombie, zombie, zombie*	
Christina Aguilera	Christina Aguilera	"Fighter" (2002)	0:19	*Well I thought that I knew you, thinkin' that you were true*	On the words "thought" and the second "that"

4.2.5 Grunt

Grunt – as established by Sadolin (2012) – describes the characteristic vocal sounds of many extreme metal sub-genres, such as black, grind and death metal. Physiologically, the production of grunt has some similarities with undertone singing used in ethnic voice techniques, like Tuvan throat-singing or Tibetan Buddhist monks' chanting. (Mesiä & Ribaldini 2015: 388.)

A clinical study conducted by Eckers et al. (2009: 1747) on six different death metal singers revealed that "... at least two forms of supraglottal laryngeal constriction are used to obtain the typical death metal sound which differs in the use of vocal folds and ventricular folds as well as in supraglottal adduction effort". Sakakibara et al. (2004) stated that the true vocal folds do not vibrate while grunting (although in their study what is here identified as 'grunt' is called 'growl', with a different meaning than the same term in §4.2.4 of this thesis). On the contrary, Eckers's experiment established that they actually partake in the phonation, in an amount varying from 23% to 100% throughout the six different subjects (2009: 1750, see also Figure 4.11). In simpler words, grunt is mostly produced by the vibration of other parts of the larynx and the vocal tract than the true vocal folds, but the latter also participate, although less evidently than in non-grunted phonation. Erbe summarizes this with the statement "vocal fold vibration either plays a less important role or is suppressed altogether […]" (Erbe 2014: 67).

Figure 4.11 - Voiced and unvoiced frames in two examples of grunt

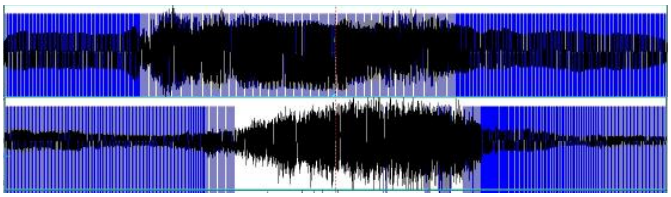


Figure 4.11: Two examples of grunting by different singers. Both examples show a clean part before and after grunting. On top, the voice signal with 0% unvoiced frames in the grunt part (which means that the vocal folds are always closed during the grunted phonation). At the bottom, the voice signal with 77% unvoiced frames in the grunt part (the vocal folds are mostly open during the grunted phonation). (Eckers et al. 2009: 1749)

The study by Eckers et al. (2009) shows that six different death metal singers all achieved the grunt sound in slightly different ways. Therefore, it is not possible to summarize one and only definitive grunt technique at the moment, although there are extensive similarities. As already stated in §4.2.3, grunt and other distorting effects have been commonly regarded as vocally dangerous for many decades, especially in the tradition of Euroclassical vocal practices. Nevertheless:

> The Voice Handicap Index did not show some distinctive voice disorders. Even with the interview this could not be concluded. But there were mentioned clear factors of stress in producing growling for a longer period of time. More than ca. 2 hours of growl production lead to various occurrences of hoarseness or scratch of throat. The VHI was afterwards not the best method to investigate voice disorders. A screening or logopedic investigation might have been more informative. (Eckers, Hütz, Kob, Murphy, Houben & Lehnert 2009: 1750.)

Since grunt requires a particular configuration of the vocal folds, i.e. open and scarcely participating in the phonation, Mesiä and I previously categorized grunt as a special register. Nevertheless, I here consider it an effect, since Eckers's study proves that vocal fold vibration is minimal, but present. This means that, although drowned in white noise, there is a fundamental tone underneath the distortion, and the distortion happens 'on top' of an otherwise regular vibration of the vocal folds. The amount of such distortion is usually so great, that the clean tone of the singer's voice is hardly recognizable anymore. As a consequence, grunting males and females are much more difficult to be distinguished from each other, and this phenomenon has opened the way for many female singers towards a vocalist career in extreme metal bands.

Table 4.11 - Examples of grunt

Singer	Artist	Song	Time	Lyrics	Additional notes
Tapio Wilska	Finntroll	"Trollhammaren" (2004)	0:34 →	*Bland skuggor rider en odjur*	
Angela Gossow	Arch Enemy	"Nemesis" (2005)	0:20 →	*We walk this earth*	Female
Yannis Papadopoulos	Beast In Black	"Beast in Black" (2017)	0:37	*The spawn of evil celebrates*	On the syllable "-le-" in "celebrates"
Tatiana Shmailyuk	Jinjer	"Pisces" (2016)	1:11 →	*Scale armour belies*	Female
Mark "Barney" Greenway	Napalm Death	"The Wolf I Feed" (2012)	0:28 →	*The wolf I feed*	
Quorthon	Bathory	"A Fine Day to Die" (1988)	3:10		Combined with some other distortion
Tomi Joutsen	Amorphis	"Towards and Against" (2007)	0:48	*By stone-shoed wanderer*	
Lacey Mosley	Flyleaf	"I'm So Sick" (2005)	0:15	*I will break*	On the word "break", female, probably combined with distortion
Johan Hegg	Amon Amarth	"Twilight of the Thunder God" (2008)	0:40	*There comes Fenris' twin*	
Marcus Bridge	Northlane	"Rot" (2015)	0:47	*So let the world rot*	

4.3 Other vocal phenomena: height of the larynx, belting and Euroclassical

Under this category are listed some vocal phenomena that are not classifiable as either registers or effects. They are the *height of the larynx*, *belting* and the *Euroclassical style* of singing. No musical examples are provided for the height of the larynx, since it is more difficult to identify clearly than other parameters (for the reasons exposed in §2.2.1), and it is a such basic mechanism of singing that basically all the existing repertoire involving voice would be a suitable example.

4.3.1 Height of the larynx

The optimal height of the larynx in singing has been a dividing topic for a long time. Nevertheless, it is commonly agreed that lifting or lowering the larynx from its default position (where the larynx stays while not phonating) alters the sound. This is shown in Figure 4.12. When the larynx is lowered, the vocal tract is lengthened and produces a darker sound. Lifting the larynx, on the contrary, shortens the vocal tract and brightens the sound. This difference is clearly heard when comparing the classical singing tradition (lower larynx) and popular music singing (higher larynx). (Mesiä & Ribaldini 2015: 390.) A very high larynx can also be used to somehow imitate the perceptual effect of twang (Sundberg & Thalen 2010: 659).

Figure 4.12 - The height of the larynx

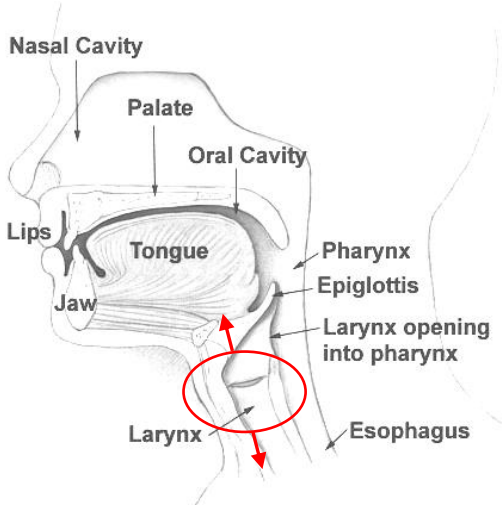


Figure 4.12: The height of the larynx can be moderately controlled in order to produce a brighter or darker sound. (Adapted from VoiceScienceWorks 2019)

4.3.2 Belting

The term ‘belting’ has also been used to identify different vocal techniques, and it has been subject to a considerable amount of scientific research in recent years. Perceptually, in belting the singer seems to reach high pitches with a loud chest register sound, and this technique is commonly found in musical theater as well as Euroclassical singing in order to make the sound more projected and mark the climax moment(s) of a piece. Nevertheless, belting is widely used in rock as well as in many forms of Afro-American music such as gospel, rhythm and blues, soul, funk and so on. It is not uncommon to compare belting to a loud shout, such as what one would use to catch the attention of someone else on the other side of a large street.

The physiology behind the term is still controversial. In a survey conducted in the USA, vocal teachers with Euroclassical background maintain that belting is “a style of forced declamation, in which the chest voice mechanism is taken upward, beyond its normal limits of range, without mixing or changing voice qualities. Some teachers assumed, on the basis of their aural perception and physiologic production, that belting is not chest voice, but a quality unique unto itself” (Spivey 2008.)

Estill Vocal Training used to identify in a backward tilting of the cricoid cartilage the key mechanism of belting. This conception has been recently put under criticism, e.g. by Kayes (2017), although it remains clear that the origin of the belted sound is a thicker and longer closure of the true vocal folds, in addition to a stronger subglottal pressure. At the moment, it is not completely clear how this kind of voice production works, nor a unanimous definition exists of ‘what belting is’. Nevertheless, it is maintained that it requires a conspicuous body support and it results in a bright, very loud sound, with a proportionally low effort by the true vocal folds (McDonald Klimek et al. 2009b: 65-76; Sundberg, Thalen & Popeil 2012; Sundberg & Thalen 2015). This is the conception of belting I refer to in this thesis.

Table 4.12 - Examples of belting

Singer	Artist	Song	Time	Lyrics	Additional notes
Bruce Dickinson	Bruce Dickinson	“Tears of the Dragon” (1994)	1:19	*I throw myself into the sea*	
Ronnie James Dio	Dio	“Rainbow in the Dark” (1983)	0:19	*When there’s lightning*	On the word “lightning”

Gary Moore	Gary Moore	"Over the Hills and Far Away" (1987)	4:37	*Over the hills*	On the word "Over". Could be mixed voice as well
Jon Bon Jovi	Bon Jovi	"Livin' on a Prayer" (1986)	3:27	-	
Tony Martin	Black Sabbath	"The Shining" (1987)	1:26	*Rise up to the shining*	On the words "Rise up"
Jeff Scott Soto	Yngwie Malmsteen	"As Above, So Below" (1984)	1:10	*'Cause I will fly*	Particularly on "fly"
Neil Carter	Gary Moore	"Thunder Rising" (1987)	1:26	*The world keeps turning*	
David Lee Roth	Van Halen	"Jump" (1984)	1:17	*Might as well jump*	On the word "well"
Steve Perry	Journey	"Don't Stop Believin'" (1981)	3:00	*Somewhere in the night*	On the word "night"
Dave Bickler	Survivor	"Eye of the Tiger" (1982)	1:40	*Watching us all with the eye*	On the word "eye"

4.3.3 Euroclassical

"The vocal technique used in Euroclassical singing has a distinct sound created by for example lowering the larynx and expanding the vocal tract. Also, the legato lines and vowel-based pronunciation differ noticeably from popular music singing." (Mesiä & Ribaldini 2015: 391.) It has not been commonly used within heavy metal music prior to the late 1990s, when the band Nightwish achieved great commercial success with the combination of heavy metal arrangements and Euroclassical singing. In metal, it is almost solely used by female singers.

When this technique is used in popular music, the degree of faithfulness to the original Euroclassical singing varies. Some singers reproduce a sound very close to the Euroclassical one, others mimick it with a sonority that reminds of it, but it is more akin to the lighter, so-called 'legit' old style commonly used in popular music before rock'n'roll rose to success. Caffier et al. provide a brief but clear panoramic of the differences between Euroclassical and popular music singing:

> Classical and nonclassical singing differ in many aspects. The classical vocal technique known as bel canto offers a vocal sound that is clear, dense, unforced, sonorous, and with a variety of color and dynamics. Other characteristics include a well-balanced amount of subglottic pressure, a stable and relatively low positioning of the larynx, a raised soft palate, an appropriate resonance strategy, trained auditory and kinesthetic feedback mechanisms for pitch control, a consistent vibrato, tall and rounded vowels, and a balanced tone quality that is equally light and dark ("chiaroscuro"). The advantage of singing in bel canto style lies in the least amount of

effort with maximum yield. The competent and careful use of this technique allows for live performances without amplification and provides efficient and healthy professional singing with a powerful voice for many years.

In contrast, contemporary nonclassical singing offers a genre- specific nonhomogenous voice quality with intentionally induced hoarseness, breathiness, distortion, and instability. These characteristic differences can be confirmed using laryngostroboscopic, acoustic-aerodynamic, functional and perceptual assessment methods. Additionally, in contemporary popular music, most singers usually use amplification. In order to achieve certain effects on the listener, rock, pop, and musical theater singers produce characteristic nonclassical vocal effects to highlight the lyrics, situation, or emotional aspects. Others try to create unique sounds specific to themselves and design new styles. (Caffier, Ahmed, del Mar, Wienhausen, Forbes, Seidner & Nawka 2018: 340.)

Table 4.13 - Examples of Euroclassical singing

Singer	Artist	Song	Time	Lyrics	Additional notes
Tarja Turunen	Nightwish	"Sleeping Sun" (1999)	3:20	*I wish for this night-time*	Female
Johanna Lesonen	Lost In Grey	"Far Beyond and Further" (2019)	0:57	*Our world falling to pieces*	Female
Heidi Parviainen	Dark Sarah	"Island in the Mist" (2016)	1:32	*Rise, like a queen*	Female
Annlouice Loegdlund	Diablo Swing Orchestra	"Voodoo mon Amour" (2012)	0:50	-	Female
Simone Simons	Epica	"Cry for the Moon" (2003)	0:12	-	Female

4.4 Summary of the recommended terminology

Table 4.14 - Summary for a terminology compendium of vocals in heavy metal

Registers	Effects	Other vocal phenomena
• Vocal fry • Modal • Falsetto • Whistle	• Vibrato • Twang • Distortions • Growl • Grunt	• Height of the larynx • Belting • Euroclassical

Table 14 summarizes a possible compendium to address heavy metal vocals, mostly from the points of view of their production (*poiesis*), and partly from the one of perception (*aesthesis*). Refer back to Chapter 1 for these two concepts.

Vocal registers mainly happen at the level of vocal folds. Effects are caused by the further intervention of other anatomical parts in the vocal tract. Other vocal phenomena are characterized by their own specific configurations of the vocal fold and vocal tract levels or activity of the external muscles of the larynx.

> If we consider the most successful and well-known traditional HM repertoire, it is clear that some features are primary to this genre. Among the registers, the modal (either speech or head, with an almost certain probability of mixing between the two) produces the most powerful and energetic sound, whereas falsetto is used more rarely due to its sometimes breathy and softer sound. Distortion, vibrato, and twang are very common, and are often combined with the desired register to create the trademark sound of a successful HM singer. (Mesiä & Ribaldini 2015: 391.)

Although distortion and grunt both produce very aggressive timbres, the former leaves audible the fundamental pitch of the tone, whereas the latter does not, therefore producing sounds which are not really 'tuned'. This is why it is more challenging to distinguish male and female voices one from another when grunting. In the last two decades, this phenomenon has favored the rise of many extreme metal bands presenting female vocalists.

5 Vocal compendium in three case studies

In this chapter, I apply the vocal compendium suggested in the end of §4 to three case studies. For this purpose, I chose three singers who, in different moments, fronted the British classic heavy metal band Black Sabbath. These singers are known by their real or stage names as Ozzy Osbourne, Ronnie James Dio and Ian Gillan. The choice of Black Sabbath has been guided by these criteria:

a) Black Sabbath is one of the longest-lasting bands in the history of heavy metal music. Its career began in the second half of the 1960s and finished only in 2017, after a span of almost fifty years. Due to its longevity, the band's musical catalogue is fairly rich.
b) Despite adapting their musical offer through the decades, Black Sabbath maintained its core musical identity within the horizon of classic heavy metal, also due to the permanence of the guitarist Tony Iommi throughout the whole career of the band.
c) Black Sabbath recruited singers with considerably different vocal characteristics and approaches to singing. This allows to present here various elements of the vocal compendium suggested in §4.

The three analyzed songs are considered in their original studio version. The purpose is not to compare the singing styles of the singers, but rather to show how the same paradigm can be applied to analyze the styles of different vocalists. Furthermore, this paradigm must be considered as a tool rather than a final description of these singers' styles. Different listeners approaching to the same performance can hear and recognize slightly different vocal techniques or elements, and even diverge in their opinions (e.g. on which part of the modal register the singer is using – chest or head – in case the performance or the melody do not allow to understand it clearly). Moreover, the intent is not to assess the possible reasons why certain vocal solutions are chosen. Most times, such voluntary or involuntary choices come from the singer's interpretation of the text, emotional involvement and technical capabilities, as well as from the structure and characteristics of the song itself.

5.1 A brief history of Black Sabbath

Here, I offer a rapid overview of the most important turning points in the band's career, as well as its primary musical characteristics. The biographical information here presented is mainly based on McIver (2009). Walser (1993) and Lilja (2009) are reference texts in case the reader needs to venture into musical analysis of other instrumental parts than the vocal ones.

Black Sabbath formed around 1968 in Birmingham (UK). After an initial span under the moniker Earth, it changed name into its definitive one. The choice of the name has been multiple times ascribed to the influence of Mario Bava's 1963 horror film *I Tre Volti Della Paura*, whose English title was indeed *Black Sabbath*. The first line-up included four members: John 'Ozzy' Osbourne on vocals, Tony Iommi on guitars, Terence 'Geezer' Butler on bass, and Bill Ward on drums.

A few years increasing success raised the four-piece to stardom. The main musical characteristics revolved around the frequent use of power-chords, the predominance of minor modes in horizontal harmony, the focus on guitar and bass riffs, and an overall 'heaviness' of the sound achieved through the rhythmic fine-tuning connecting guitar, bass and drums. The first five albums, released between 1970 and 1973, are considered seminal works in early heavy metal. In hindsight, it is generally acknowledged they contributed to shape the musical characteristics of the heavy metal genre. Iommi, whose role as the main composer continued over the whole lifespan of the band, progressively started to include more complex musical arrangements by using e.g. multi-tracking and keyboard instruments such as analog synthesizers.

At the end of the 1970s, after a couple of less commercially and critically successful records, the band decided to fire Osbourne – whose addiction to drugs and alcohol had become a liability – and to find a new singer. The new vocalist was found in Ronnie James Dio, whose previous work with the bands Elf and Rainbow had earned him a reputation as a solid front-man with a powerful and epic sound. His musical skills also allowed him to partake in the composing process much more actively than Osbourne had been able to. The two albums released with Dio on vocals restored the fame of the band, although Ward – himself plagued by alcoholism – was forced to leave before the beginning of the promotional tour for *Heaven And Hell* (1980), the first album with Dio. Drummer Vinnie Appice was hired to substitute for Ward, and he ended up playing on the next album *Mob Rules* (1981).

A clash of egos soon brought this line-up to split, with Dio and Appice leaving the band. Iommi and Butler reinstated Ward as drummer and hired former Deep Purple singer Ian Gillan. Soon, Ward was again out of the equation due to his addiction problems. The new album *Born Again* (1983) was less acclaimed than the two previous ones, and Gillan decided to leave Black Sabbath.

From the mid-1980s to the mid-1990s, the band's line-up continuously changed, with Iommi becoming the only permanent member. As far as vocals are considered, various singers took turns in fronting Black Sabbath. Glenn Hughes featured on what was supposed to be Iommi's solo album *Seventh* Star (1986) but was released under the name Black Sabbath feat. Tony Iommi. Later, several singers auditioned for the band until Tony Martin was hired. From 1987 to 1995, Martin was the lead singer on five studio albums and their promotional tours, although *Dehumanizer* (1992) featured a brief reunion of the early 1980s line-up with Dio and Appice. Black Sabbath's reputation and commercial impact progressively waned throughout the 1980s and the 1990s, partially due to the rise of younger bands and new sub-genres, and partially because of the overall crisis heavy metal as a whole encountered in the USA after the massive rise of competitor genres such as grunge and rap.

A newly kindled interest sparkled with the live record *Reunion* (1998), which featured the original 1968-1979 line-up with Osbourne, Iommi, Butler and Ward. Meanwhile, after being fired from Black Sabbath in 1979, Osbourne had become a successful solo artist and public personality, to the point that his fame had surpassed his former bandmates'. After *Reunion*, the band regularly played single shows or longer tour legs, but the members mostly focused on their own solo projects. In 2006, after the induction into both the UK Music Hall of Fame and the Rock and Roll Hall of Fame, the *Reunion* line-up was put on hiatus.

Dio and Appice joined the band once again, and Black Sabbath recorded three new songs for a greatest hits' album. The band decided to embark on a new tour under the moniker Heaven And Hell, after the namesake 1980 album. Nevertheless, the band members were keen to point out that, despite the new name, the band was still fundamentally Black Sabbath. This also clarified that the songs that were going to be played on the upcoming world tour would be only from the Dio-era. In 2009, Heaven And Hell released a new record, *The Devil You Know*. This line-up completed a world tour but definitely disbanded when Ronnie James Dio died from cancer in May 2010.

After Dio's death, Black Sabbath reunited and played new live shows with Osbourne on vocals and his solo band's drummer Tommy Clufetos on drums. In 2013, Black Sabbath released its last album

13, produced by Rick Rubin and featuring three of the original Black Sabbath members – Osbourne, Iommi and Butler – with the addition of Brad Wilk (Rage Against The Machine) on drums. After a long farewell tour, the band officially quit their career playing a final show on 4th February 2017 in their native town Birmingham.

5.2 Analysis

I analyze each one of the three case studies in the following way. First, I briefly introduce the singer who sang the original studio version. Second, I briefly present the song by mentioning its main musical characteristics. Third, I introduce the lyrics, which are divided into different sections identified by letters and numbers (e.g. A 1, A 2, B 1, B 2, C). I have made this division according to the melodic content of each lyrical section: sections with a similar melody are identified by the same letter. Fourth, I offer a schematic analysis of the vocals through music notation and the vocal compendium offered in Chapter 4. In some cases, repeated sections with different lyrics are not analyzed: in this case, the same analysis made on a section can be applied to the following section with the same letter. I have specified these cases in the preparatory description of the song. Fifth, I shortly comment each section's analysis with notes and observations (if necessary).

5.2.1 "War Pigs" (*Paranoid*, 1970)

John "Ozzy" Osbourne (1948) is one of the founding members of Black Sabbath, having been the band's singer since its foundation until 1979. After his departure from Black Sabbath, Osbourne proceeded – with the aid of his wife and manager Sharon Arden – to build up a successful solo career which consecrated him as a prominent rock star throughout the 1980s and 1990s. His and his family's extravagant life have also been the main attraction in the early 2000s reality show *The Osbournes*.

[A 1] 1:03-1:47

Generals gathered in their masses
Just like witches at black masses
Evil minds that plot destruction

Sorcerers of death's construction
In the fields the bodies burning
As the war machine keeps turning
Death and hatred to mankind
Poisoning their brainwashed minds... Oh lord yeah!

[B 1] 2:18-2:38

Politicians hide themselves away
They only started the war
Why should they go out to fight?
They leave that all to the poor, yeah!

[B 2] 2:49-3:10

Time will tell on their power minds
Making war just for fun
Treating people just like pawns in chess
Wait 'till their judgment day comes, yeah!

[A 2] 4:40-5:22

Now in darkness, world stops turning
As you hear the bodies burning
No more war pigs of the power
Hand of God has struck the hour
Day of judgment, god is calling
On their knees, the war pigs crawling
Begging mercy for their sins
Satan, laughing, spreads his wings
All right now!

"War Pigs" is an almost 8-minute long song with a relatively scarce involvement of vocals. Osbourne intervenes with his singing only in slightly more than a fourth of the whole piece. The complex structure of this song is an example of the early repertoire of Black Sabbath, which often includes long instrumental sections or solos, and in which sometimes the vocals play a marginal role.

The melodic content is divided into two sections [A] and [B], which are both repeated twice. Within each section, the melodies are quite simple and repetitive. The vocal performance is also fairly similar between the two different repetitions of each section. Therefore, I hear analyze extensively only [A1] and [B1] (notation in Figures 5.1 and 5.2), implying that more or less the same observations can be made for [A2] and [B2].

Figure 5.1 - War Pigs. A1 and A2 [1:03-1:47 & 4:40-5:22]

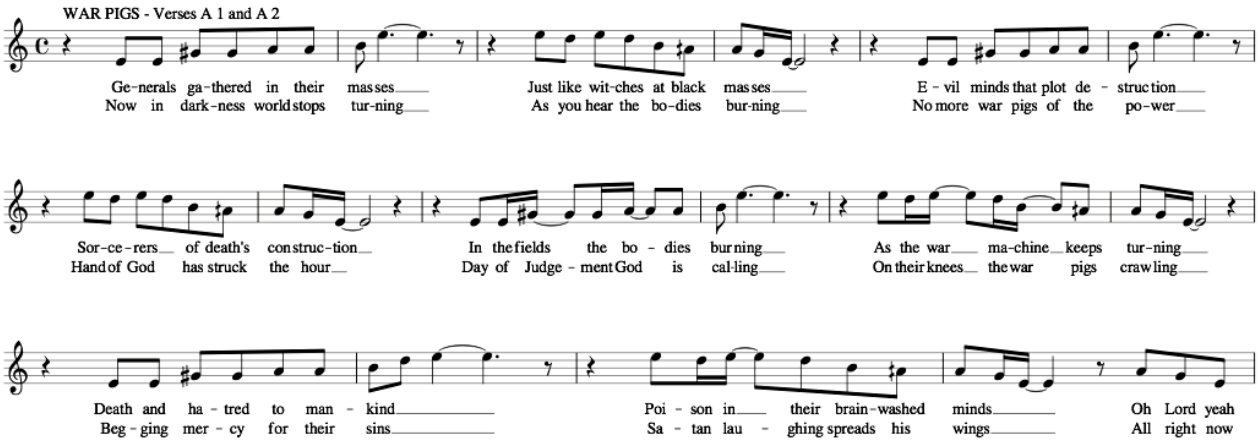


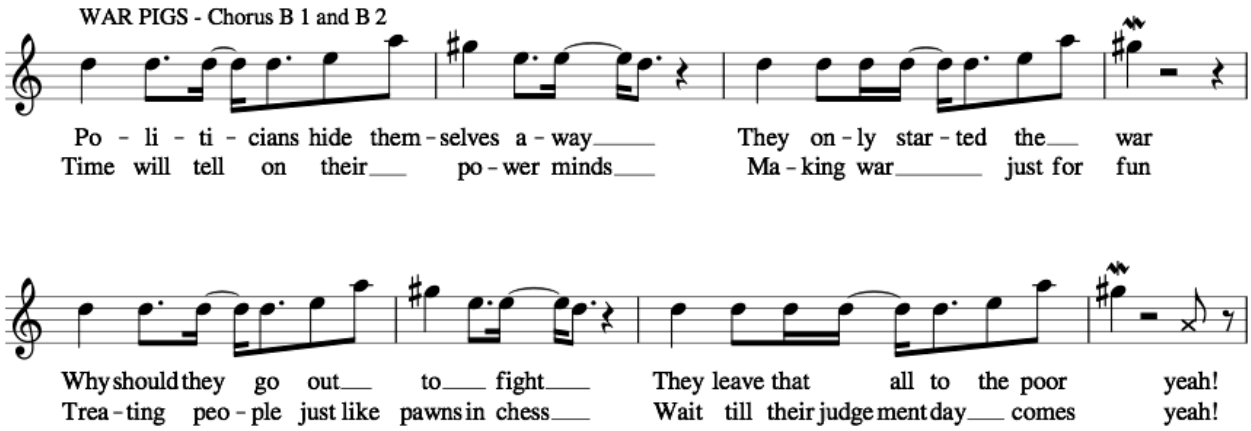
Table 5.15 – War Pigs. A 1

[A 1] 1:03-1:47	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *Generals gathered in their masses*	Modal with mixing – chest in the first part, head from "*in*"	Twang, vibrato	High larynx	Possible lack of body support causes pitch imbalances; over-adduction of the vocal folds
[2] *Just like witches at black masses*	Modal with mixing – head in the first part, chest from "*black*"	Twang, vibrato	High larynx	See [1]

[3] *Evil minds that plot destruction*	See [1]	See [1], light distortion	See [1]	See [1]
[4] *Sorcerers of death's construction*	See [2]	See [2]	See [2]	See [1]
[5] *In the fields the bodies burning*	See [1]	See [1], vibrato	See [1]	See [1]
[6] *As the war machine keeps turning*	See [2]	See [2], vibrato	See [2]	See [1]
[7] *Death and hatred to mankind*	See [1]	See [1], light distortion	See [1]	See [1]
[8] *Poisoning their brainwashed minds... Oh lord yeah!*	See [2]; head on "*oh lord yeah!*"	See [2], light distortion	See [2]; belting on "*oh lord yeah!*"	See [1]

As it is characteristic of most Osbourne's performances, twang is constantly used both in the low and the high modal register. On high notes, this produces a particularly piercing and metallic sound, which is furtherly enhanced by the high position of the larynx. Osbourne consistently uses a powerful phonation which might derive more from an over-adduction of his vocal folds than proper body support. Vibrato is sometimes used at the end of phrases to keep long tones. Alternatively, some long syllables are distorted (it is not clear whether this distortion is intentional or not). The final shouted exclamation "oh lord yeah" is possibly produced through belting.

Figure 5.2 - War Pigs. B1 and B2 [2:18-2:38 & 2:49-3:10]



Although the melody in the [B] section is different, the characteristics of Osbourne's singing remain quite unchanged, as shown in the table below.

Table 5.16 - War Pigs. B 1

[B 1] 2:18-2:38	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *Politicians hide themselves away*	Modal with mixing – chest on "*politicians*", later head	Twang	High larynx	
[2] *They only started the war*	Modal with mixing – chest on "*They only started*", later head	See [1]	See [1]	The embellishment on "*war*" is not properly vibrato, but probably uses a similar physiological mechanism
[3] *Why should they go out to fight*	Modal with mixing – chest on "*Why should the go*", later head	See [1], light distortion	See [1]	
[4] *They leave that all to the poor, yeah!*	Modal with mixing – chest on "*They leave that all*", later head; "*yeah!*" is a clear example of mixing downwards	See [1]	See [1]	See [2]

5.2.2 “Heaven and Hell” (*Heaven And Hell*, 1980)

Ronnie James Dio (1942-2010) was an American singer, trumpetist and bassist who joined Black Sabbath in 1980, after an already successful career with bands such Elf and Rainbow. He fronted Black Sabbath until 1982, after which he pursued a career with his self-named band. Dio rejoined Black Sabbath briefly in 1992, then in 2006 when the band’s moniker changed into Heaven And Hell. In addition to providing vocals to the bands he fronted, Dio often took part in the songwriting and the lyrics-writing. He died of stomach cancer in 2010.

[A 1] 0:32-0:53

Sing me a song, you're a singer
Do me a wrong, you're a bringer of evil
The Devil is never a maker
The less that you give, you're a taker

[B 1] 0:53-1:04

So it's on and on and on, it's Heaven and Hell, oh well

[A 2] 1:15-1:37

The lover of life's not a sinner
The ending is just a beginner
The closer you get to the meaning
The sooner you'll know that you're dreaming

[B 2] 1:37-2:35

So it's on and on and on, oh it's on and on and on
It goes on and on and on, Heaven and Hell
I can tell, fool, fool!

[C] 2:35-2:46

(Ad lib)

[A 3] 2:46-3:17

Well if it seems to be real, it's illusion
For every moment of truth, there's confusion in life
Love can be seen as the answer, but nobody bleeds for the dancer
And it's on and on, on and on and on....

[D 1] 4:44-4:56

They say that life's a carousel
Spinning fast, you've got to ride it well
The world is full of Kings and Queens
Who blind your eyes then steal your dreams
It's Heaven and Hell, oh well

[D 2] 4:56-5:12

And they'll tell you black is really white
The moon is just the sun at night
And when you walk in golden halls
You get to keep the gold that falls
It's Heaven and Hell, oh no!

[E] 5:12-5:30

Fool, fool!
You've got to bleed for the dancer!
Fool, fool!
Look for the answer!
Fool, fool, fool!

"Heaven and Hell" is also a long piece with a relatively complex structure, but it is more focused on vocals compared to "War Pigs". Furthermore, the vocals in the second chorus and bridge, which I refer to as [B 2] and [C] respectively, are partially reinforced by backing vocals. The latter part of the song presents clearly new musical material and a faster tempo. Basically, the same analysis can be applied to sections [D 1] and [D 2], therefore I here present only the latter. Notation is from the first and third verse [A 1] and [A 3] (Figures 5.3 and 5.7), the first and second choruses [B 1 and B 2] (Figures 5.4 and 5.5), the bridge [C] (Figure 5.6) and from [D 2] (Figure 5.8).

Figure 5.3 - Heaven and Hell. A1 [0:32-0:53]

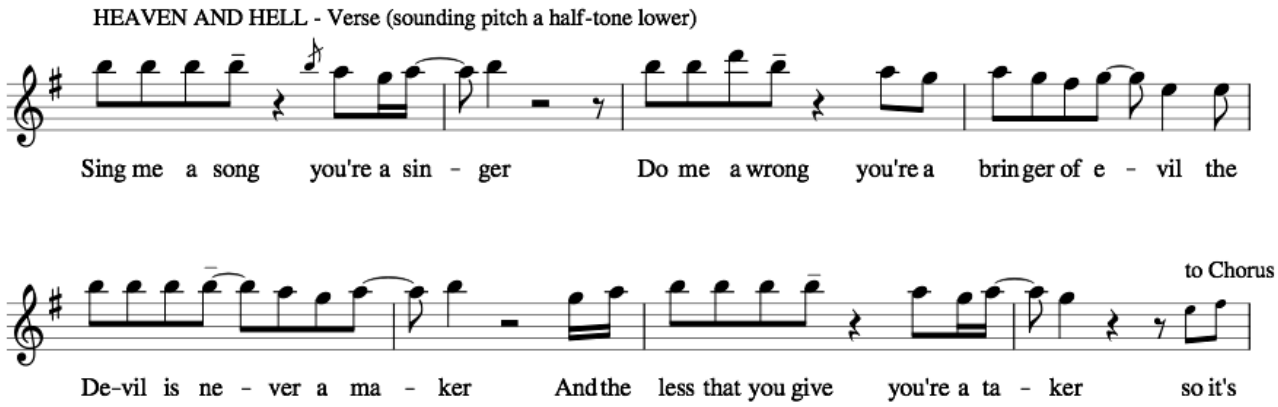


Table 5.17 - Heaven and Hell. A1

[A 1] 0:32-0:53	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *Sing me a song, you're a singer*	Modal with mixing – head		Light belting in the first half	
[2] *Do me a wrong, you're a bringer of evil*	Modal with mixing – head until chest on "e-*vil*"	Distortion on "*wrong*"	See [1]	
[3] *The Devil is never a maker*	See [1]	Light distortion on "*Devil*" and "*never*"; vibrato on "*maker*"	See [1]	
[4] *The less that you give, you're a taker*	See [1]	Distortion on "*that*"		

Figure 5.4 - Heaven and Hell. B1 [0:53-1:04]

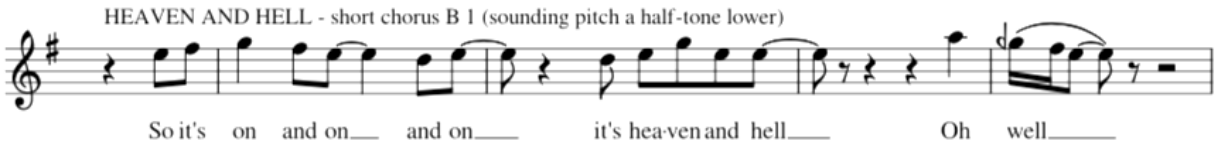


Table 5.18 - Heaven and Hell. B1 and A2

[B 1] 0:53-1:04	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *So it's on and on and on*	Modal with mixing – head	Vibrato		
[2] *It's heaven and hell*	See [1]	Distortion on "*hell*"		
[3] *Oh well!*	See [1]	Vibrato	Belting	
[A 2] 1:15-1:37	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *The lover of life's not a sinner*	Modal with mixing – head	Light distortion	Light belting in the first half	
[2] *The ending is just a beginner*	Modal with mixing + falsetto on "begin-*ner*"			Lighter voice with more mixing
[3] *The closer you get to the meaning*	See [1]			Lighter voice with more mixing
[4] *The sooner you know that you're dreaming*	Modal with mixing – head	Light distortion on "*know*"	Light belting on "*know*"	

Figure 5.5 - Heaven and Hell. B2 [1:37-2:35]

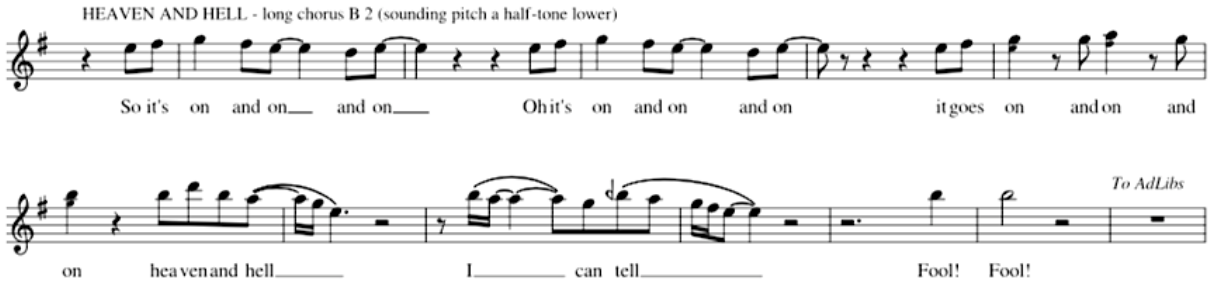


Table 5.19 - Heaven and Hell. B2

[B 2] 1:37-2:35	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *So it's on and on and on*	Modal with mixing – head	Vibrato on the words "*on*"		
[2] *Oh it's on and on and on*	See [1]	See [1]		
[3] *It goes on and on and on*	See [1]		Light belting	Backing vocals
[4] *Heaven and Hell*	Modal with mixing – head until chest on "*Hell*"	Distortion, vibrato		
[5] *I can tell*	Modal with mixing – head	See [4]	Light belting on "*I*"	
[6] *Fool, fool!*	Modal or falsetto!?	Vibrato		

Figure 5.6 - Heaven and Hell. C [2:35-2:46]

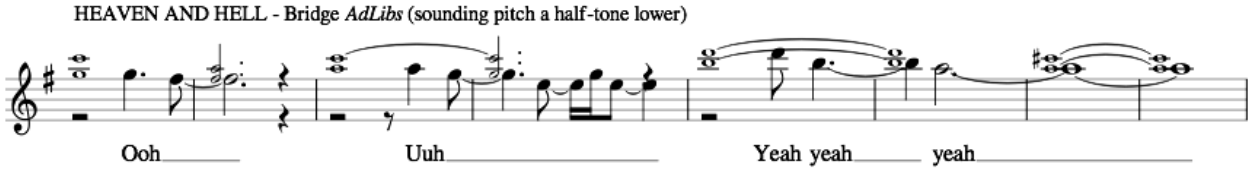


Table 5.20 – Heaven and Hell. C

[C] 2:35-2:46	Registers	Effects	Other	Additional Notes
[1] *(first ad lib)*	Modal with mixing – head	Vibrato		
[2] *(second ad lib)*	See [1]	See [1]		
[3] *yeah yeah yeah!*	See [1]	See [1]		Increased mixing

From the tables above, it is noticeable that in the first part of the song Dio mostly stays in a mixed head register, with only seldom changes to chest when the melody touches lower notes and one occasion in which falsetto might be used (although it is difficult to determine). Vibrato is very frequent, whereas distortion is occasionally used to emphasize single words. Belting sometimes brightens and confers further power to certain words or phrases, but it is not a constant.

Figure 5.7 - Heaven and Hell. A3 [2:46-3:17]

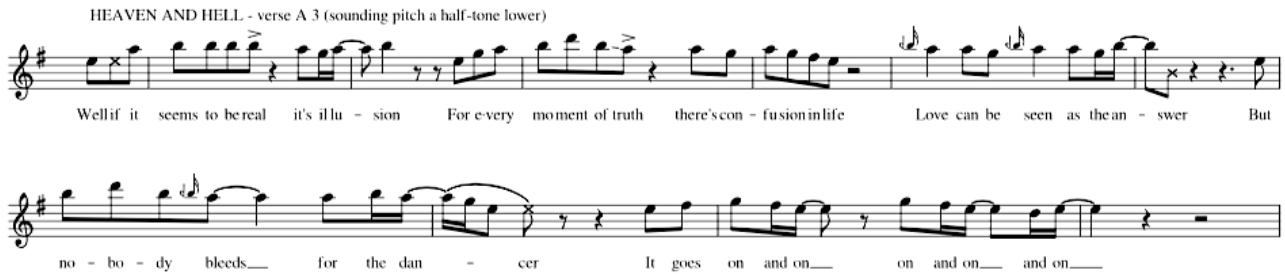


Table 5.21 - Heaven and Hell. A3

[A 3] 2:46-3:17	Registers	Effects	Other	Additional Notes
[1] *Well if it seems to be real it's illusion*	Modal with mixing – head	Vibrato, distortion		

[2] *For every moment of truth there's confusion in life*	Modal – head to chest	Distortion	Light belting on "*of*"	More percussive articulation, no vibrato
[3] *Love can be seen as the answer*	See [1]	See [2]		No vibrato on long notes
[4] *But nobody bleeds for the dancer*	See [1]	Light distortion		See [3]
[5] *And it's on and on, on and on and on*	Modal – head to chest	See [4]		

Figure 5.8 - Heaven And Hell. D2 [4:56-5:12]

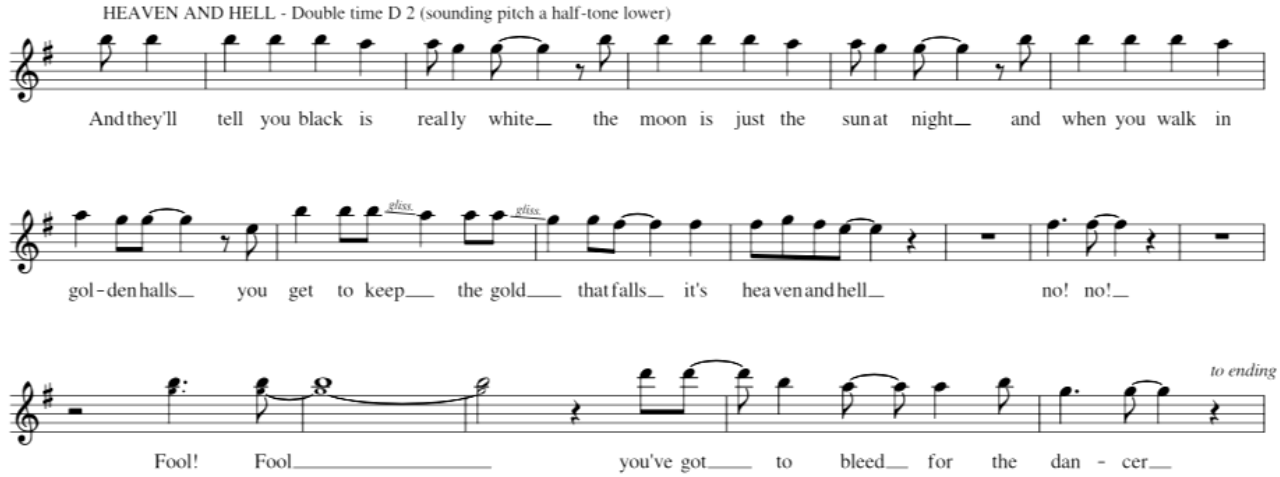


Table 5.22 - Heaven And Hell. D2 and E

[D 2] 4:56-5:12	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *And they'll tell you black is really white*	Modal with mixing – head	Light distortion		
[2] *The moon is just the sun at night*	See [1]	See [1]		
[3] *And when you walk in golden halls*	See [1]	Distortion		

[4] *You get to keep the gold that falls*	See [1]	Distortion		
[5] *It's Heaven and Hell*	Modal with mixing – head or chest?	See [1]	The larynx seems to set slightly	
[6] *oh no!*	Modal – chest, falsetto might come as an effect between the two words		Probably lower larynx	No distortion
[E] 5:12-5:30	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *Fool fool!*	Modal with mixing – head	Vibrato		Backing vocals
[2] *You've got to bleed for the dancer*	See [1]	Distortion	Light belting on "*got*"	
[3] *Fool fool!*	See [1]	See [1]		No backing vocals
[4] *Look for the answer*	See [1]	Vibrato, distortion		
[5] *Fool! Fool! Fool!*	See [1]			No vibrato

In the second part of the song, distortion is clearly used more often and consistently. Vibrato is sometimes left aside in favor of straighter tones, and the register choices are consistent with the ones in the first table. As an overall analysis of Dio's singing in this song, it is possible to identify distortions, vibrato, and the almost exclusive use of the mixed head voice as key characteristics.

5.2.3 "Born Again" (*Born Again*, 1983)

Ian Gillan (1945) is primarily known as the singer in the second line-up of Deep Purple, another British band that, more or less at the same time as Black Sabbath, contributed to define the canons of early heavy metal music. Gillan joined Deep Purple in 1969 and fronted the band until 1973, when he was fired mostly due to abuse of alcohol and to the conflict between him and Deep Purple's guitarist Ritchie Blackmore. From 1973 to 1984, he dedicated himself to an intermittent solo career. In 1984 he rejoined the reborn Deep Purple, which had temporarily disbanded in 1976. Since then,

he has constantly fronted the band, except for a short hiatus between the 1980s and the 1990s. Gillan sang in Black Sabbath only for a short period of time, in which the band released the studio album *Born Again* (1983) and toured to promote the album.

[A 1] 0:51-1:26

As you look through my window
Deep into my room
At the tapestries all faded
Their vague and distant glories concealed in the gloom
The icy fingers of forgotten passions
Softly brushing my lips
At the tips of my primitive soul

[A 2] 1:27-2:01

As you look through my door
Deep into my room
Can you feel the mighty wall of power
It's waiting, waiting in the gloom
The distant shadows of forgotten champions
Those who live in me still
And will rise when we challenge and kill

[B 1] 2:01-2:18

Born again
You'll be born again
(AdLib)

[A 3] 2:18-2:53

Look at this prince of evil

Fighting for your mind
Fighting all the priests of shame
For the thrust of my challenge is aimed at the hearts
Of mutant gods who think we're all the same
They're controlling our minds
And they use us for fortune and fame

[A 4] 2:55-3:30

As you look through my window
Deep into my room
At your future and freedom
The grey and plastic retards all floating in circles
And as you taste the fruits of new sensations
Softly brushing your lips
As we rise when we challenge and kill

[B 2] 3:30-3:49

Born again
You'll be born again
(AdLib)

[C] 3:49-4:45

Born again
You'll be born again
If you want to be king for a day
Just do what I say

Born again
You'll be born again
Everybody's got to think like a hunter
Just search for your prey

Born again
You'll be born again
Be alive through the night and the day
Just do it my way

Like “War Pigs” and “Heaven and Hell”, “Born Again” is a long piece. Compared to the other two songs, it has a simpler structure, with an intro over which the vocal melody of the verse is sung [A] and a chorus [B]. The final part is formed by [A] and [B] in conjunction, but I have labelled it as [C] for better clarity. Due to the similarity of the melodic content, I present notation only from [A 1], [A 2] and [B 1] (Figures 5.9, 5.10 and 5.11 respectively).

Figure 5.9 - Born Again. A1 and A2 [0:51-2:01]

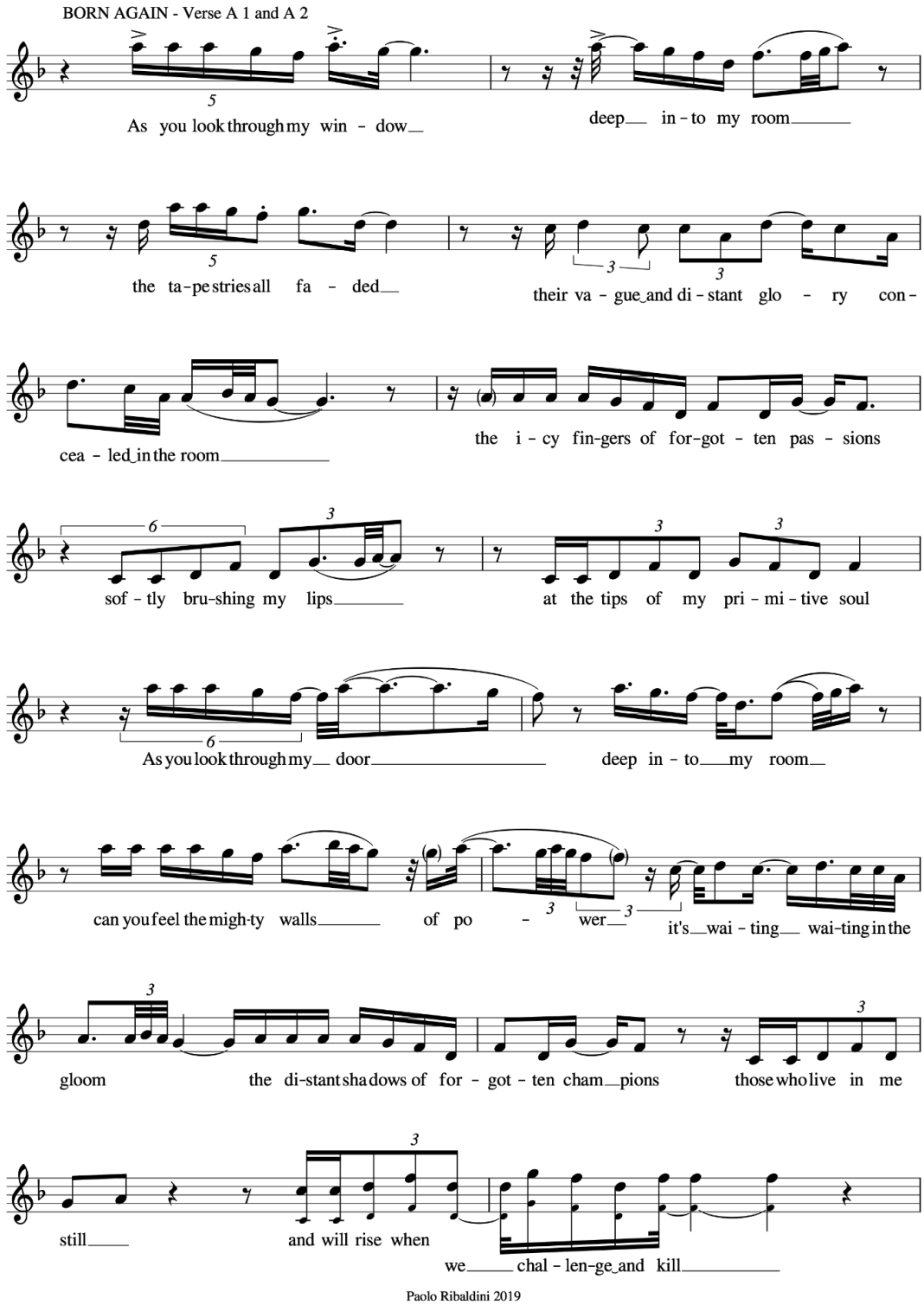


Table 5.23 - Born Again. A1 and A2

[A 1] 0:51-1:26	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *As you look through my window*	Modal – head	Twang, distortion, vibrato on "win-*dow*"	High larynx	Possible over-adduction of the vocal folds
[2] *Deep into my room*	Modal with mixing – head	Twang, distortion	See [1]	See [1]
[3] *At the tapestries all faded*	See [2]	Twang, distortion, vibrato on "fa-*ded*"	See [1]	See [1]
[4] *Their vague and distant glories*	See [2]	Twang	Middle larynx?	No distortion or vibrato
[5] *Concealed in the gloom*	Modal with mixing – head to chest	Vibrato	See [4]	No distortion, vibrato or exceptional amount of twang; the phonation seems more relaxed
[6] *The icy fingers of forgotten passions*	Modal – chest, falsetto on "*passions*"		See [4]	See [5]
[7] *Softly brushing my lips*	Modal – chest, falsetto on "*lips*"		See [4]	See [5]
[8-A1] *At the tips of my primitive soul*	Modal – chest		See [4]	See [5]
[8-A2] *And will rise when we challenge and kill*	Modal – head	Twang, vibrato	High larynx	

From the table regarding the verses, it is possible to notice how the register shifts from head to chest with mixing, while twang and a high larynx seem to be constant. The larynx sounds being in a more relaxed position when the melody sets on lower pitches. Vibrato is also sporadically used. This kind of phonation has been a constant in Gillan's singing since the 1980s.

Figure 5.10 - Born Again. B1 [2:01-2:18]

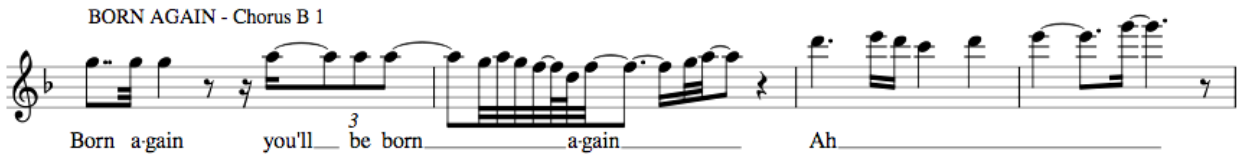


Table 5.24 - Born Again. B1

[B 1] 2:01-2:18	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *Born again*	Modal with mixing – head	Twang, distortion	High larynx	
[2] *You'll be born again*	See [1]	See [1]	See [1]	
[3] *(Ad libitum)*	Modal – head	See [1]	See [1]	Backing vocals

In the chorus, the melody rises to noticeably higher pitches, and backing vocals are used to emphasize the last notes. Distortion becomes a constant of this section and adds power to the vocal sound.

Table 5.25 - Born Again. C

[C] 3:49-4:45	**Registers**	**Effects**	**Other**	**Additional Notes**
[1] *Born again*	Modal – head	Twang, vibrato	High larynx	Possible over-adduction of the vocal folds
[2] *You'll be born again*	See [1]	Twang, distortion, vibrato	See [1]	
[3] *If you want to be king for a day (just)*	Modal with mixing – head	Twang	See [1]	
[4] *Do what I say*	Modal – chest	Twang, vibrato	See [1]	No distortion or vibrato or exceptional amount of twang

[5] *Born again*	Modal – head	Twang	See [1]	Vocal breaks used as effect
[6] *You'll be born again*	Modal with mixing – head to chest	Twang	See [1]	See [5]
[7] *Everybody's got to think like a hunter (just)*	Modal with mixing – head	Twang, distortion	See [1]	
[8] *Search for your prey*	Modal – chest		See [1]	No distortion, vibrato or exceptional amount of twang
[9] *Born again*	Modal – head	[See 8]	See [1]	
[10] *You'll be born*	See [9]	Twang, distortion	See [1]	
[11] *Be alive through the night and the day (just)*	Modal with mixing – head	See [10]	See [1]	
[12] *Do it my way*	Modal – chest		See [1]	No distortion or vibrato

The final [C] section presents more or less the same vocal devices as the verse or the chorus, but the overall energy devoted to the phonation seems to be greater. The larynx stays in a high position, and twang is constantly used. Distortion is more present compared to the verses, and an interesting addition is represented by the use of vocal breaks as effects, arguably in order to emphasize the emotional delivery of the last phrases.

6 Conclusions

Although extremely polyhedral and certainly tied to the specific characteristics of each individuals, vocal practices in the music genre of heavy metal share some common functioning mechanisms of the singing voice. My purpose in this thesis was not to reduce this never-ending complexity to a simplistic classification, but rather to expose the underlying shared elements of such complexity. While some specific vocal sounds can be considered predominant in heavy metal music, they are not the only one, nor they belong exclusively to this genre.

I exposed the need – due to the absence of connection between the academic field of heavy metal studies and the vast family of clinical disciplines grouped under the collective label of 'vocal science' – of creating a bridging paradigm in order to provide heavy metal scholars with an analytic frame for heavy metal vocals. With this purpose in mind, I offered an overview of the most general and basic mechanisms behind two fundamental parameters of phonation, which in vocal science are commonly referred to as 'source' and 'filter'.

I divided the vocal elements addressed in this thesis into three categories, according to a classification already adopted in my collaboration with Susanna Mesiä (Mesiä & Ribaldini 2015). For each element, I provided an explanation of its role in singing and its basic functioning mechanisms, as well as a list of concrete examples from heavy metal songs. Vocal registers are configurations of the true vocal folds. The latter vibrate when met by the airflow originated in the lungs, and they produce the fundamental frequency of the vocal sound. These registers are vocal fry, modal (divided into low/chest and high/head), falsetto and whistle. These are the basis of the singing phonation and a constituent parameter of the singing tone. In the examples and the case studies provided in Chapter 4 and Chapter 5 respectively, modal appeared to form the overwhelming majority of the register texture, with a recurring use of mixing to conceal the vocal break between the two parts of modal. Vocal fry usually functions as emotional emphasizer at the beginning of phrases, although it is not uncommon to find it in their middle or at their end. The light and effortless sound of falsetto, even though perhaps more popular in other music genres, is also frequently used as an expressive tool in quiet moments.

Vocal effects that singers may add to their voice were here categorized as vibrato, twang, distortion, growl and grunt. Matching the common idea of heavy metal vocals as aggressive and rough, the

various forms of distortion and grunt seem to be the most recurring and easily retrievable. While grunt mostly characterizes extreme metal artists, distortion is a cross-style expressive device. The various techniques employed to achieve distortion – as well as their combinations – constitute a separate topic of studies. Vibrato and twang, although common in traditional and pop metal, are scarcely used in the extreme sub-genre. Growl is quite foreign to heavy metal, whereas examples can easily be found in other genres of popular music, such as pop, soul, funk and gospel. In general, it seems that traditional and pop metal use different vocal effects than the extreme sub-genre, with the sole exception of distortions.

The last category included vocal phenomena which could not be ascribed to either registers or effects. Those here presented were the height of the larynx, belting and the Euroclassical style of singing. The height of the larynx – similarly to registers – is a necessary and unavoidable parameter of vocal sounds, and it usually depends on the individual singer's technique, as well as the musical purpose of the vocal line and other variables such as registers or vocal effects. Belting, a vocal technique whose definitive identity and physiological characteristics have still to be established, seems to appear in some cases within the traditional and pop metal sub-genres. Various degrees of faithfulness to Euroclassical singing have found more and more space in the heavy metal scene since the worldwide success achieved by the Finnish band Nightwish at the turn of the 21st Century. Unlike the others vocal elements analyzed and exemplified in this thesis, Euroclassical singing in heavy metal is almost solely used by female singers.

The analysis of three case studies from the discography of the British band Black Sabbath, with each of them presenting a different singer, is a practical example of how the analytical tools provided in this thesis can be applied to a concrete vocal performance. As a result, I believe the functionality and utility of such tools has been proven. Nevertheless, several questions remain open to future investigation in the traces of this thesis. How can the complex category of distortions be furtherly diversified? Can new elements be identified from the combination of the ones mentioned in this thesis? Are there other parameters which can be taken into account when analyzing vocal performances in heavy metal from the poietic perspective? Is there a way to create an even tighter connection between heavy metal studies and voice sciences? Can the tools here provided bring further benefit to aesthesic analysis? These and other possible questions constitute the object for future research.

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